REVISITING THE DEMAND FOR GMO PRODUCTS: DOES INFORMATION ABOUT FOOD WASTE INFLUENCE CONSUMER PREFERENCES?

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ABSTRACT

As consumer demand for organic and non-GE foods continues to grow, GE crops with food-waste reduction benefits are being developed, but the adoption of these GE varieties depends heavily on consumer acceptance. Past research suggests products containing GE ingredients are stigmatized more heavily than non-GE products. However, given the potential of new GE foods to reduce food waste, in this paper I investigate how different information about GE foods influences consumer preferences for conventional, organic, and Non-GMO labeled snack products. Using a discrete choice survey, I ask participants to choose between two versions of the same snack product as the price varies; one of the snack products is always conventional, and the other product is USDA organic, Non-GMO certified, or both. Overall, I find that positive information about the food-waste reduction abilities of GE foods does not significantly influence a consumer's preference for snack products.

BIOGRAPHICAL SKETCH

Rachel Saputo received her Bachelor of Arts in Environmental Studies from the University of California, Santa Barbara in 2012. She then worked for two years at an organic kale chip company in the California Bay Area before attending Cornell University in pursuit of a graduate degree. After obtaining her M.P.S. in Applied Behavioral Economics from Cornell's Dyson School in 2015, Rachel Saputo decided to pursue her M.S. in Food and Agricultural Economics in order to continue developing her analytical and quantitative research skills. Rachel's passion is healthy, sustainable food and enjoys cooking for friends and family, spending time outdoors, and traveling.

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United Nations (UN)

Food and Agriculture Organization (FAO)

Environmental Protection Agency (EPA)

Genetically engineered (GE)

Genetically modified organisms (GMO's)

Genetically modified (GM)

United States Department of Agriculture (USDA)

Food and Drug Administration (FDA)

Economic Research Service (ERS)

Willingness To Pay (WTP)

Willingness To Accept (WTA)

Random Utility Model (RUM)

Regular Consumers of Organic Foods (RCOF)

Occasional Consumer of Organic Food (OCOF)

Independent and Identically Distributed (IID)

Analysis of Variance (ANOVA)

I. Introduction

The tremendous amount of food wasted in the U.S. has become a prominent social, environmental and economic issue across various sectors. Reducing the amount of food waste throughout all levels of the supply chain has been identified as one approach to increase food availability and lower the food industry's environmental impact by efficiently allocating resources and reducing greenhouse gas emissions. While genetic engineering is a promising technology that can reduce food waste and lower the agriculture industry's carbon footprint, past research has consistently found that consumers are generally averse to GE foods produced with biotechnology. Even though there is agreement among the scientific community that GE foods are as safe for consumption as their conventional counterparts, some consumers are still skeptical of biotechnology's potential health or environmental impacts and so prefer to avoid GE foods by purchasing organic and Non-GMO products. However, some studies have found that consumers would value more tangible benefits afforded by GE foods.

In the last few years, new GE varieties have been developed to have substantial food waste reduction benefits at the harvest, storage, transportation, processing and consumer level. The Innate Potato and Arctic Apple are the first of these new GE varieties to be approved by all required agencies. However, it is unclear if producers will be optimistic about adopting these new GE varieties given that GE foods are stigmatized and will soon be labeled.

This research study is designed to investigate if consumers would be more willing to accept GE foods that have food waste reduction benefits. To answer this research question, we develop a binary stated discrete choice survey in which participants are presented two versions of five snack products: a conventional Frito-Lay snack product that has been produced with genetic engineering, and the *Simply* version of that same product that is either organic, Non-GMO certified, or both.

Participants are asked thirty-five times to choose between these two versions of the products as the price varies. This survey is run on five different groups of participants, and four of the five survey samples received information about GE foods, including a basic disclosure paragraph akin to a label and information about the scientific safety and/or food waste benefits of GE foods. By comparing the choices made between these different groups, we hope to uncover if and to what extent positive information about GE foods influences consumer preferences for conventional, organic and Non-GMO foods.

1.1 Primary Motivation: Food Security and Food Waste

The United Nations (UN) projects the world population will rise to 9.6 billion by 2050. In order to meet the growing needs and changing diets of the world's inhabitants, the UN's Food and Agriculture Organization (FAO) estimates that between a 70% to 100% increase in agricultural food production will be necessary (FAO, 2009). The majority of this population growth will occur in developing countries and be largely concentrated in urban areas. As incomes in developing countries rise, the demand for more meat-based meals and proteins is expected to increase. The diverse and meat-centric diet of the growing population will place a greater demand on earth's natural resources than ever before. The ability to meet this goal is compounded by many challenges, including climate change, political instability, volatile energy prices and competing national policies; merely increasing agricultural production at the aggregate level is not a sufficient method to addressing food security (UN 2009). In order to ensure an adequate and healthy food supply for future generations, food and agricultural policies must not only be aimed at making production more resource efficient, but policies must also encourage an equitable, affordable distribution of food products and ensure appropriate measures are implemented and technologies are adopted to reduce food waste.

According to estimates by the FAO, approximately one third of all food produced for consumption is lost or wasted throughout the food supply chain (2015). In 2014, the US Environmental Protection Agency (EPA) estimated that total food waste constituted 21.6% of all discarded municipal solid waste, and Bloom (2010) calculated that approximately 160 billion pounds of food is wasted on an annual basis. The national annual cost of food waste is estimated between $161.6 and $165.6 billion, representing squandered resources that went into the production, distribution, and marketing of food products (Buzby et al., 2012; Newsome et al., 2014). Furthermore, approximately 44.2 million Americans, or 13% of households, were classified as being food insecure in 2015 (Feeding America, 2016). Given these conflicting paradigms and the large social, economic, and environmental costs of food waste, fostering the development and adoption of food waste reduction strategies to help achieve food security is now a priority among governmental agencies, food industry stakeholders, and consumer groups.

1.2 Genetic Engineering: Opportunities and Obstacles

While humans have been working to improve agricultural products in order to extract the maximum environmental, economic and social efficiencies since the advent of agriculture, technological advancements have spurred great developments in recent years. Particularly in the last two decades, genetic engineering has been introduced and employed to increase yields, decrease per acre costs, and stabilize agricultural production strategies. Some biotechnology companies have also highlighted ways that genetically engineered crops, notably fruit and vegetable crops, have the capacity to reduce food waste. Historically, biotechnology developments have largely been geared towards realizing efficiencies in food production methods by allowing farmers to increase yields, reduce inputs and costs, control pests, and better manage the natural resources on which they rely. In fact, Khush (2012) states, “GM/biotech crops are the fastest adopted crop technology in the history of modern agriculture.” Currently the following genetically engineered (GE) fruits and vegetables, otherwise known as genetically modified organisms (GMO’s), are commercially cultivated: corn, cotton, soybeans, canola (rapeseed), sugar beets, alfalfa, papaya, and squash (USDA 2014). Since 1996, many of these GE foods have proliferated throughout the U.S. food supply chain. Gaskell et al. (2004) broadly describes the stated benefits of GE crops as increasing productivity for farmers, allowing for lower pesticide usage and costs, and reducing environmental pollution from lower herbicide and pesticide applications. Now in the past two years, GE crops are being developed specifically with the goal of reducing food waste at the farm, storage, and processing levels.

Despite all of the documented benefits of GE crops, many environmental and consumer advocacy groups are against modifying crops via genetic engineering. Some anti-GMO advocates argue that altering the DNA of organisms may have unforeseen health consequences which may not be immediately apparent, and others are concerned about the ethics of genetically modifying organisms (Gaskell et al. 2004). Other opponents widely contest the proclaimed environmental benefits, stating traits like herbicide tolerance and pest resistance give rise to super-weeds and super-pests, which in turn leads to over application of herbicides and pesticides. The ERS echoes some of these environmentalists’ concerns, reporting that one of the most pressing issues facing U.S. crop producers, and specifically soybean and corn growers, is that “glyphosate’s effectiveness is declining as weed resistance mounts” (2015). Credited, albeit liberally biased, news sources have perpetuated such claims including GE crops have not accelerated increases in crop yields, nor has GE reduced the usage of pesticides (Hakim 2016). Over application of pesticides and herbicides can also negatively affect ecosystems by impairing soil productivity, decreasing biodiversity or polluting waterways, as is seen by the Gulf of Mexico's dead zone (NOAA 2015). Environmentalists also allude to scientists' concerns that pesticides, specifically neonicotinoids, negatively affect bumble bee colony growth; this can severely impact the ability of bees to pollinate plants, which in turn can have serious implications for food security (Whitehorn et al. 2012). These are only a few examples among a host of problems with which environmentalists take issue.

Regardless of the countless papers and studies that document the pros and cons of GE foods, GE agricultural products continue to be developed and approved by the FDA and EPA. As a consequence, since the introduction of GE foods to the marketplace in 1996, the benefits and negative consequences of GE foods have given rise to highly publicized debates and remains a polarizing issue among governments, food industry stakeholders, and consumers.

1.3 Potential of Genetic Engineering as a Food Waste Reduction Strategy

Recent developments in biotechnology have enabled many environmental benefits to be realized. Specifically, biotechnology companies have begun developing GE varieties with the explicit intention of reducing food loss resulting from the production, processing and storage of certain crops. One example is the Innate Potato developed by Simplot, which have been in development for over a decade. First generation Innate Potatoes were created to reduce the amount of potato waste resulting from bruising and black spots. Second generation Innate Potatoes will have even greater food waste benefits by addressing "shrink from cold storage, light blight, sugar ends, acrylamide and black spot bruise" (Simplot, 2016). These food-waste reduction benefits are achieved using RNAi gene silencing technology, which essentially regulates the potato genes accountable for the enzymatic darkening process, making Innate Potatoes less susceptible to browning and bruising than their conventional counterparts. The ability of Innate Potatoes to resist browning and bruising leads to reductions in food-waste throughout the supply chain, from harvest to food preparation. Simplot estimates that Innate Potatoes have the potential to reduce post-harvest potato food waste by 400 million pounds annually, a figure that translates to consumers throwing away up to 28% fewer fresh potatoes, which is equivalent to 3 billion pounds per year (2016). All Innate Potatoes, along with any other new GE crop, undergo a thoroughly regulatory review and must be vetted by the United States Department of Agriculture (USDA), Food and Drug Administration (FDA), and EPA before being authorized for commercial production. These reviews include years of safety and environmental assessments as well as extensive field trials.

Another example of a GE crop developed to reduce food waste is the Arctic Apple developed by Okanagan Specialty Fruits. An estimated 40% of apples are wasted, the majority of which are discarded due to cosmetic deficiencies including browning or bruising (Okanagan Specialty Fruits, 2016). Marketed as the "nonbrowning" apple, Arctic Apples are primed to reduce the amount of apples thrown away due to these artificial cosmetic deficiencies.

However, whether the food waste reduction benefits of the Innate Potato and Arctic Apple will be realized depends heavily on whether producers adopt these varieties, which in turn depends heavily on consumer acceptance of these GE foods. Other trends in the food industry including increased transparency and growing consumer preferences for organic and non-GMO products, especially among Millennials and as these products become more affordable, suggests these GE varieties may be difficult to market to both producers and consumers. Such advancements have great potential to significantly mitigate food losses across the supply chain. However, the development, adoption and success of these new GE crop varieties in the marketplace is heavily dependent on consumer acceptance of biotechnology and GE foods.

1.4 Growing Demand for Organic Foods

There may perhaps be no food issue of greater contention in modern history than GE food products. While adoption of GE crops by farmers in the United States has leveled out since 2012, as shown in Figure 1.1 in the Appendix, this smoothing is mostly attributable to market penetration. New GE varieties continue to be developed and approved, but since the late 2000's, no new GE crops have captured the market the same way that GE corn, soybeans, cotton, and canola have. U.S. farmers have shown interest in adopting new GE varieties, but the research findings reported above suggest consumer acceptance may seriously implicate the development of new GE food products as well as approval of GE crops in developing countries. While GE technology continues to be adopted more quickly than any other agricultural technology, the organic food industry is expanding rapidly; indeed, the organic agriculture sector is "one of the fastest growing segments of U.S. agriculture" (ERS 2014). By definition, no crop certified organic can be genetically modified. The USDA reports that between 2014 and 2015, the number of domestically certified organic production operations increased nearly 12% (USDA 2016). In the United States alone, the Organic Trade Association estimates the organic retail market was valued at more than $39 billion in 2014, which is $4 billion greater than the ERS's estimates (2015).

Some of the reasons consumers prefer organically produced food over conventionally grown or GE food is because of the perceived benefits of organic agricultural production; for example, consumers tend to believe organic food is healthier, higher in nutrients, contain less pesticide residue, and more environmentally sustainable (ERS 2014). The Economic Research

Service (ERS) of the USDA estimates that the majority of American consumers consume organic products “at least occasionally,” and consumers are clearly willing to pay a premium for organic products (2014). While this only accounts for 7% of all food sales, Figure 1.2 in the appendix visually demonstrates the magnitude at which the organic industry is experiencing growth. The breakdown of U.S. organic sales are as follows: 43% produce, 15% dairy, 11% packaged/prepared foods, 11% beverages, 9% breads and gains, 5% snack foods, 3% meat/fish/poultry, and 3% condiments (ERS 2014). Based on these statistics, it appears that consumers are most concerned with their health, which is the primary driver of organic food purchases. This hypothesis is starting to be supported by research; in a study conducted by Bernard and Bernard, (2010) consumers were willing to pay more for potatoes that were produced without the use of pesticides, regardless of their demographic variables. This is an interesting trend because as incomes rise, people tend to be more disposed to buy organic food. Furthermore, those in high-income brackets are also more likely to be educated, but one would expect highly educated individuals would accept the scientific consensus and have high acceptance of GE technology and foods.

Projections suggest that demand for organic products will continue to rise, and as organic and Non-GMO products often command premium prices, producers and manufacturers have incentives to capitalize on this growing market. Consumers of organic products generally view organic foods as higher quality, healthier, safer, and tastier than their conventional counterparts (Hughner et al. 2007). Some consumers also opt for organically grown or Non-GMO products to avoid genetically engineered (GE) ingredients. The availability of information, social media, and an overall trend towards increased corporate transparency are a few factors that have contributed to greater consumer awareness regarding the presence of GMO’s in food and beverage products. As a consequence, there has been a movement driven largely by consumer advocacy groups to label food products that contain GE ingredients. Food companies have also begun labeling products that explicitly are GE-free.

However, prior research suggests that foods labeled as GE are stigmatized, and consumers are willing to pay less for foods produced with genetic engineering. Because foods produced with GE ingredients have not been labeled as such until recently, there is little empirical evidence to support this research. Furthermore, given that research suggests genetic engineering has the ability to deliver many advantages to both producers and consumers and GE foods do not pose any health risk, labeling GE food products could thwart the adoption of new GE varieties that have the potential to deliver great social, health, and environmental benefits.

1.5 Research Objective

Educating consumers of the benefits of GE crops while reaffirming the established safety of GE technology has been suggested as one method to allay consumer fears about GE foods, as research suggests that consumers averse to GE foods are unaware, don't fully understand, or trust the technology and/or benefits. Thus, logic follows that bridging the information gap by educating consumers of the safety and benefits of GE foods should help alleviate preexisting concerns and consumers therefore shouldn't be as averse to consuming GE foods, especially when conventional food products are less expensive than the organic and Non-GMO versions of the same product.

Past research studies suggest that the effects of information on influencing consumer preferences is often asymmetrical (Baker and Burnham 2001, Gaskell et al. 2004, Lusk et al. 2001, Lusk et al. 2004, Lusk et al. 2005). Participants have suggested that environmental benefits, such as the ability to reduce waste, are somewhat more desirable motivations to adopt GE products than producer-related benefits (Lusk et al. 2015). Nevertheless, consumer acceptance still appears to be primarily driven by more direct tangible benefits, such as lower prices or improved nutrient content.

However, there has been a resurgence in environmental sustainability in the last decade, and today's generations are more environmentally conscious than past. Given the ability of information to influence preferences, informing shoppers of the environmental benefits of certain GE foods, such as highlighting their potential to reduce food waste, ought to make these consumers less inclined to purchase the more expensive organic or Non-GMO version of that product because these versions do not deliver the same food waste benefits.

To test this hypothesis, we developed a discrete choice survey to better understand if consumers would be more willing to accept GE food products if informed of the environmental benefits, specifically that these GE varieties help reduce food waste. We use conventional and *Simply* Frito-Lay products because they are the most popular snack chip brand, well recognized by consumers of all ages, and the two product lines are identical except in the ingredients. Rather than elicit willingness to pay (WTP) measures, we simply ask subjects to choose their preferred snack product between the conventional Frito-Lay and *Simply* brands as the prices of those products vary.

This research contributes to the literature by examining how consumer preferences for conventional products and products labeled USDA organic or Non-GMO certified changes when we provide consumers with additional information and vary the price of the food products. Our results suggest that consumers are price sensitive, preferring the conventional Frito-Lay branded product over the *Simply* version when the *Simply* is more expensive, but participants seem to be unresponsive to the information treatments, suggesting priorly held beliefs and opinions have a stronger influence on guiding preferences than new information. However, when subjects were asked if they would like to learn more about the difference between 1st and 2nd generation GE foods, 49% of subjects said yes, and after receiving additional information about the differences, 38% (of the 49%) said they'd be more willing to purchase and consume 2nd generation GE foods. Our results therefore infer implications for future development of 2nd generation GE food products to address environmental concerns.

In addition to disentangling how various information treatments and price differentials influence consumer preferences for food product attributes, I also assess how a subject's self-reported view and understanding GE foods and technology influences their preferences, all while accounting for socio-demographic factors. Overall, the key objective is to develop a deeper understanding of how consumer preferences for the organic or Non-GMO attributes changes relative to conventional food products produced with GE ingredients when consumers are provided additional information, contingent on price variations. Given the continuing consumer trend towards organic and Non-GMO foods, these results have larger implications regarding the potential for 2nd generation GE varieties to deliver food waste benefits.

1.6 Thesis Outline

I first describe the recent movement to label GE foods in the United States before providing a thorough review of past peer-reviewed research conducted regarding consumer acceptance of GE foods. In my literature review, I discuss the signaling effect of GE labels as well as factors that influence a consumer's level of acceptance and preference for conventional, GE, Non-GMO, and organic foods. The role of information, risk and prior opinions is also examined. Then in the following section, I describe the conceptual and quantitative framework employed to examine how information about food waste influences consumer preferences for GE and Non-GE food. The experimental design is then introduced, followed by a thorough discussion regarding the appropriateness of the random utility theory for this survey. Next the methodology section generates the theoretical framework and econometric specifications of the logit and mixed logit models. I then outline the hypotheses being investigated before describing the data using summary statistics and figures. The results and analysis section follows, which includes a comprehensive discussion of all model results. Lastly, I discuss the implications of these research findings and concluding remarks.

II. Literature Review

2.1 Labeling of Genetically Engineered Foods

Despite ample research that suggests GE foods are as safe for human consumption as conventional and organic foods, many consumers have adverse attitudes to GE foods; these attitudes are reflected in their preferences and purchasing habits. In response, a growing national movement to label GE foods and foods containing GE ingredients has burgeoned. A 2013 telephone poll found that 93% of the 1,052 people interviewed were in favor of labeling foods containing GE ingredients, and approximately 75% were worried that GE technology could adversely affect people's health (Kopicki 2013). Furthermore, half of respondents declared they would not consume GE fruits or vegetables (Kopicki 2013).

These risk averse consumers and other conscious shoppers that wish to avoid GE foods have plenty of options from which to choose. By definition, products certified USDA organic cannot be made with genetic engineering or contain any GE ingredients. In May 2015, the U.S. House of Representatives passed the Safe and Accurate Food Labeling Act of 2015, which will establish a federal standard for producers that wish to voluntarily label foods containing GE ingredients. The USDA will be in charge of offering the agency's "Processed Verified Seal" for food companies wishing to authenticate their Non-GMO claims. The proliferation of GE foods throughout the food supply has also given way to third party verification systems such as the Non-GMO Project, a non-profit organization that currently labels roughly 35,000 food products with their Non-GMO seal (2016).[1]

Furthermore, in the last ten years many state initiatives have been introduced to make regulating and labeling products that contain GE ingredients mandatory. For years large food companies have been adamantly fighting state initiatives, such as Prop 37 in California back in 2012, because they were concerned labeling products would suggest to consumers GE foods weren't as safe for consumption and they were worried about sales declining. Vermont was the first state to launch a successful bid to require mandatory labeling of GE ingredients, a law that would have gone into effect in July 2016. However, in July 2016 the federal government passed a national labeling bill that directs the USDA to develop a comprehensive labeling standard over the next two years to provide food manufacturers many options to label products. For example, to inform consumers that a product contains GE ingredients, food producers can use plain text, symbols, or QR codes, which would allow consumers to scan for product information with their smart phones (Wheeler and Carney 2016).

Even before this legislation was passed, the marketplace was already preparing to label GE products in order to provide consumers with transparent options. Whole Foods, one of the largest natural and organic food retailers, was the first food retailer committed to labeling all GE products in their stores by 2018 in order to provide greater transparency for their conscious

[1] The Non-GMO Project is a third party verification program that outsources certification to four companies. While each company has their own distinct approval processes, all products submitted for verification must meet the guidelines outlined in the Non-GMO Project Standard, which ensures the appropriate processes are in place for the purposes of testing, traceability, segregation, formulation, labeling, and quality assurance (2016).

shoppers. Furthermore, in a move that defied the engrained stance of the food industry, Campbell's was the first national food manufacturing company to not only open support mandatory GMO labeling on a national scale, but also agreed to voluntarily label their products that contain GE ingredients in 2016. General Mills also announced in early 2016 that they would label food products containing GE's, but specifically noted that this decision was mostly founded in economic rationale as a result of Vermont's labeling law (2016). Interestingly, General Mills also states on their website, "In the spirit of transparency, we've enrolled several products – especially our organic products – in the U.S. Non-GMO Project" (2016). Such a statement demonstrates that General Mills is aware that even though consumers should have no reason to be averse to GE foods, some will still prefer to purchase organic and non-GE foods.

Such regulatory and market-based labeling initiatives may potentially give rise to a host of challenges, as research suggests GE foods may be stigmatized more than conventionally grown foods. The aforementioned proactive labeling decisions by major food manufacturers suggest they are preemptively trying to avoid mandatory labeling from conferring some food safety warning (Marchant, Cardineau, and Redick 2010). Food manufacturers now also must decide whether to label products produced with GE ingredients, or substitute out any GE ingredients with non-GE alternatives to avoid GE labels. The latter option could prove very costly for food processors, as non-GE commodities are often more expensive than their conventional GE counterpart. Studies also show that consumers are willing to pay more to avoid GE ingredients, which may have implications for future adoption of new GE varieties (Baker and Burnham 2001, Colson and Huffman 2011, Costanigro and Lusk 2014, Huffman 2010, Lusk et al. 2004, Lusk et al. 2005). Therefore, the labeling of GE foods could not only have severe economic consequences for the producers, handlers and retailers of GE products, but could also hinder the ability of GE technology to deliver benefits to consumers and society.

2.2 Review of Research on Consumer Acceptance of Genetically Engineered Foods

Because GE foods have proven to be such a contentious issue, researchers across universities and the public and private sector have thoroughly examined the multitude of factors that contribute to consumer acceptance of GE foods. Generally speaking, an individual's general attitudes towards matters such as the environment, public health and technology influence how an individual perceives the risks and benefits associated with GE food production and their overall attitude towards GE foods. The media also significant influences how consumers perceive GE technology. Countless experiments and surveys have been conducted since the early 2000's to determine the extent to which consumer acceptance of GE foods varies; the majority of these studies suggest GE foods are stigmatized despite all the evidence that shows GE foods are as safe for consumption as non-GE foods (Costanigro and Lusk 2014).

Specifically, research regarding how GE labeling influences consumers suggests foods labeled as GE, regardless of the technology, are perceived more negatively and less desirably than foods not produced using GE technology. The majority of these studies have been conducted using contingent valuation methods in which participants are asked their WTP or willingness to accept (WTA) GE foods. These studies, which have been primarily conducted in the United States and the European Union, have demonstrated that foods that do not contain any GE ingredients can elicit a premium price, but a consumer's WTP also varies depending on the specific benefits provided by the GE technology. The USDA's ERS also found that consumer acceptance of GE foods depends primarily on the observable and known product characteristics, but also depends on an individual’s risk preferences (2014).

In 2005, Lusk et al. conduct a meta-analysis including twenty-five studies completed between 1992 and 2003 that looked at valuations for GE and non-GE foods. Lusk et al. (2005) report that “across all studies, consumers on average placed anywhere from a 42% (unweighted average using all data) to a 23% (weighted average excluding one outlier) higher value for non-GM food relative to GM food.” Research also suggests that labels indicating a food “contains” a certain ingredient provoke a stronger negative reaction than “free from” labels (Costanigro and Lusk 2014). Subjects in a study conducted by Liaukonyte et al. (2013) were WTP 67% less for a product that carried a “contains” disclaimer in contrast to when that product bore no label. These results are reflected in food prices; organic foods and products labeled non-GMO are often marked at higher price points than their conventional counterparts.

Not surprisingly, Lusk et al. (2005) also find that consumers in the European Union valued non-GE foods higher than American consumers. The United States and European Union have taken very different approaches to labeling GE foods. Currently, the European Union legally mandates that all food made via genetic engineering must display some sort of label indicating the food product was produced using genetic modification, either on the packaging or the shelf (European Commission 2016). It is therefore not surprising that research shows that in the EU, where GE labeling is mandatory, consumers are primed to be wary of GE foods. This meta-analysis also did not find significant differences between valuation estimates given by student samples and those provided by more nationally representative population samples (Lusk et al. 2005). Furthermore, this meta-analysis as well as other studies have not found that demographic variables are significant predictors in whether or not an individual is likely to be accepting of GE foods (Lusk et al. 2005, 2006).

Since 2005, dozens of additional research studies have been conducted to further examine the nuances of consumer acceptance of GE foods. Overall, labels promoting attributes or a production technique tend to stigmatize comparable products that don't state those claims, and many times food labels are often interpreted beyond their literal meaning (CAST 2015). For example, some people associate organic food as healthier, although the label does not indicate any such claim, demonstrating the extent to which labels are subject to interpretation. The majority of research undertaken since the mid 2000's suggests that making additional consumer benefits known to shoppers may positively influence their preferences for GE foods. Lusk et al. (2015) report consumers are more willing to accept GE foods if it there are more obvious benefits for consumers (such as lower prices, improvements to nutritional content, and reduction in food waste) whereas consumers find GE technologies that largely provide benefits producers less desirable (such as those that allow farmers to apply herbicides that kills weeds but not crops).

While consumers initially tend to resist new technology, research suggests genetic engineering has been largely rejected because the benefits have not been apparent or tangible to consumers. More recently, advances in biotechnology have been tailored to bring more tangible, monetary, sustainability and nutritional benefits to the consumer. In March 2015, the FDA and USDA approved two varieties of GE apples, Golden Delicious and Granny Smith, and two varieties of GE "Innate" potatoes for commercial production and distribution. These GE apples and potatoes are expected to be available for purchase by 2017. First generation GE crops like soybean, canola, maize, sugar beets and alfalfa were developed in order to provide producers with production-related efficiencies, but the second generation of GE crops, like these potatoes and apples, are being designed to bring benefits to not only producers and processors, but also to consumers. The ERS explains, "the first generation features enhanced input traits such as herbicide tolerance, resistance to insects, and resistance to environmental stress (like drought)," whereas second generation crops will feature value-added traits, including nutrient-enhanced seeds (2014). Some of the advertised benefits of Simplot's Innate potatoes include a reduction in food waste due to decreased browning and bruising, and lower acrylamide levels as a result of lower asparagine concentrations (2016).

2.3 Consumer Acceptance of 1st and 2nd Generation GE Crops

Furthermore, the technology used to create second generation crops is different than the technology used to produce the most commonly cultivated first-generation GE products including corn, soy, etc.; first generation crops contain transferred gene from an unrelated species or plant variety, whereas second-generation crops are intragenic, meaning they are produced with the use of transferred genes from a plant within the same species (ERS 2014). However, because these second-generation GE food products have not yet been widely developed or adopted, the majority of consumers are unaware of the benefits derived from the differences in GE technologies. However, Huffman (2010) found that consumers are WTP between a 19-26% premium for an intragenic food that has enhanced-vitamin content. Consumers were also willing to pay more for transgenic food that had greater nutritional value, although there was not a statistically significant difference between the premiums for intragenic- and transgenic-enhanced vitamins, except when participants were provided with pro-biotech information (Huffman 2010, ERS 2014). Colson and Huffman (2011) also find that while consumers do place a greater value on nutrient enhanced fresh vegetables, the use of intragenic technology will garner a higher WTP than if these traits were obtained via transgenic modification. Their research suggests that consumers prefer the use of intragenics to transgenics, which involves inserting foreign genetic material from another species, to achieve nutritional enhancements (Colson and Huffman 2011). Overall, the literature suggests that second-generation GE foods will be more positively received and accepted than first generation technology, as consumers are less skeptical of the GE technology.

Research also supports the hypothesis that consumers may be more willing to accept 2nd generation GE crops because these varieties will finally allow consumers to realize and experience some of the benefits of GE foods. Lusk et al. (2005) report that when consumers are the direct recipients of the benefits provided by GE technology, they are more accepting of GE food. While in general, consumers are willing to pay more for food that is specifically labeled as non-GE, Lusk et al. (2005) find that the premium values consumers are willing to pay for non-GE food can be reduced by 49% if the consumer experiences a direct, tangible benefit (such as nutritional enhancement), narrowing the price differentiation between GE and non-GE foods. Other benefits of genetic engineering including increases in antioxidant content, flavor improvements, and decrease in insecticide usage are also valued by consumers. (Kaye-Blake et al. 2005). However, the few studies that have investigated how consumers assess environmental benefits of GE production indicate that some positive externalities, such as a reduced carbon footprint, may be undervalued relative to other consumer benefits (Lusk et al. 2015).

WTP for GE foods varies by food product. While consumers appear to be least accepting of GE meats, placing the lowest WTP's on GE meat products, consumers are the least averse to purchasing GE oils and place a higher value on GE oils (Lusk et al. 2005). Lusk points out that "oil made from GM corn and soybeans does not actually contain any GM ingredients, as current applications of biotechnology do not alter fat cells in plants" implying the results are intuitive, but it is highly unlikely that the public is aware of this specific scientific detail (2005). A more realistic explanation for the difference in WTP's for various GE foods stems from an individual's innate preferences or attitudes towards food safety and GE technology.

Lusk et al. (2014) also find that consumers like fresh GE foods less than processed GE foods. When a fresh food is labeled GE, the decrease in demand is greater than the decrease in demand for a processed product labeled GE. These results suggest fresh GE foods are discounted more than processed GE foods, which may pose challenges for the marketing of fresh GE crops like the Innate Potato and Arctic Apple.

2.4 The Role of Information, Risk and Opinions on Consumer Acceptance of GE Foods

The role of information is also a vital factor to consider when examining consumer acceptance of GE foods. Lusk et al. (2004) conducted an incentive-compatible study in which participants were asked their WTA in order to consumer a GE chocolate chip cookie. Participants were then given information regarding the environmental, health and world benefits of GE technology, and then once again were asked their WTA to consume the GE cookie. The results were surprising – while consumers in North America significantly decreased the amount of compensation required to consume the GE cookie, the information treatment did not significantly affect French consumers; on the contrary, Lusk et al, (2004) report that "French consumers actually demanded more compensation to consume the GM cookie after receiving information on the benefits of GM food production to the environment." One possible explanation for this finding is that new information does not necessarily change people's priorly held opinions, or may only do so in the short-term (CAST 2015).

Overall the authors of the CAST report argue that it is unwise to assume “all consumers will acquire and process information in the same rational, objective way” (2015). For example, we cannot assume that environmentally conscious consumers would be more receptive to shifting their food preferences after being provided information about the food-waste reduction capabilities of GE foods. In fact, educating consumers about biotechnology may be futile if the consumer's aversion to GMO’s stems from their belief that genetic engineering is unnatural due to human intervention (CAST 2015). Because of the long-term unknown risks of biotechnology, the lack of control consumers feel they have contributes to their unwillingness to consumer GE foods. Bialkova, Grunert, and van Trijp (2013) also found that too much information irrelevant to a consumers decision making process may decrease their attention span. Therefore, while the majority of research suggests that consumer valuation of GE food can be altered with additional information, the magnitude of the changes can vary greatly depending on an individual’s characteristics and preconceived opinions.

Overall, researchers find that when GE foods bring tangible consumer benefits and consumers are informed of these benefits, the premium consumers are willing to pay for non-GE foods is decreased (Lusk et al. 2005). This finding is not that surprising because as demonstrated by the rise of the organic sector, consumers are currently willing to pay more for organic food because they believe organic production may provide a range of benefits, from decreased pesticide residue to increased nutritional value. Therefore, if GE foods can bring similar benefits, consumers should be willing to pay comparable values for organic and the enhanced-GE foods. However, if the positive benefits are not immediately apparent or conveyed to the consumer, risk preferences may alter a consumer’s preference for GE foods. Baker and Burnham (2001) provide evidence suggesting if consumers are unaware of the benefits provided by the GE technology, they are more likely to be “reluctant to accept even small perceived risks associated with the products of genetic engineering.” Employing conjoint analysis to examine the relationship between an individual’s characteristics and their likelihood of accepting GE foods, Baker and Burnham (2001) found that “risk” and “gmo_opinion” had the most significant impacts on the probability of an individual’s acceptance level. In their logit model, they report “the coefficient on the RISK variable was negative, indicating consumers with lower levels of risk aversion were more likely to be accepting of GMO foods” whereas “the sign on the GMO_OPINION variable was positive, suggesting those consumers who tended to believe GMOs enhance the quality or safety of foods are consequently more likely to be accepting of GMO foods” (Baker and Burnham 2001).

Gaskell et al. (2004) take a different stance, arguing, “it is not so much the perception of risks as the absence of benefits that is the basis of the widespread rejection of GM foods and crops.” Additional evidence for this explanation is provided by Lusk et al. (2006): “Results indicate that the lower the level of perceived risk and the higher the perceived benefit, the lower the compensation demanded.” However, 62% of those sampled by Gaskell et al. (2004) perceive neither the risks, nor the benefits, associated with GE foods, but 83% expressed straight out opposition to GM foods. Gaskell et al. (2004) argue that this widespread opposition to GE crops is the result of the public’s failure and inability to properly understand and assess risk, pointing to the plethora of risk assessment and scientific studies that show GE crops pose no unique dangers. Costa-Font and Mossialos (2007) also suggest that, “those individuals that are likely to identify high risks with regard to GM food might be those who also identify lower benefits.” While it is reasonable to assume that risks and benefits may be simultaneously determined, these researchers fail to note that risk preferences cannot be deemed “wrong” as individuals receive differing levels of utility based on whether or not their choices are in line with their risk preferences. It is also possible that even consumers that do understand the benefits of GE technology may have high levels of risk aversion; therefore, the benefit cost ratio they use to determine whether or not they will accept GE technology is smaller, which thereby influences their preference to avoid GE foods. Economics is founded on the notion that consumers have varying preferences and receive utility from their choices. For example, a risk averse individual receives a greater level of utility by ensuring his or her choices reduce the probability of risk. Furthermore, people are even willing to pay a premium in the form of insurance to guarantee they are avoiding a possible risk. Costa-Font and Mossialos (2007) echo this claim, stating “that risk perceptions are the result of both a perception of a potential disutility as well as a lack of benefits from some new technologies such as the current generation of GM food which does not yet provide sizeable benefits for the public.” Because newer varieties of GE crops will provide more direct consumer benefits, it is also likely that these tangible benefits could help to outweigh the perceived risks associated with GE technology.

Even though consumers do have varying reasons for objecting GE crops, Gaskell et al. (2004) are correct in noting that, “public skepticism has been largely framed as a risk issue.” Many researchers suggest the media is in part responsible for amplifying such propaganda, further contributing widespread misperception of risk among consumers. Fox, Hayes and Shogren (2002) found that negative, unscientific information perpetuated by activist groups was more influential than science based, factual information in swaying consumer choices. This finding is mirrored in the movement to label GE foods; in 2015, the Pew Research Center found that 88% of scientists believed GE’s foods to be safe, whereas only 37% of the public believes the same. It is likely that media propaganda helped propel this disparate trend. In response to such manipulation of public opinion, Gaskell et al. (2004) note, “a widely proposed and supported solution is the dissemination of accurate risk information by credible and trustworthy sources."

However, as previously discussed, research regarding how information affects consumer's acceptance of GE food is mixed. Often advocates of GE foods suggest that education can help inform consumers that GE technology is safe, but Baker and Burnham's (2001) conjoint analysis study demonstrated that knowledge was less of a predictor of whether a consumer will be accepting of GE foods than opinion; this result is important because it suggests that even highly educated individuals that may be aware of the nuances of GE technology might still be opposed to GE foods. Such aversion is also apparent in the growth of the organic food sector. Interestingly, an individual's scientific knowledge is also a significant predictor of whether they accept GE's. Costa-Font and Mossialos (2007) state, "science significantly affects perceptions of benefits, whereby the larger the individual knowledge of biotech-related facts generally, the larger the perceived benefits of GM food." They further argue this "fear of the unknown underlying individual perceptions of GM food" can be explained by the inability of stakeholders to deliver a coherent story of GE food's potential benefits and consequences to society (Costa-Font and Mossialos 2007).

Because the literature suggests consumer acceptance of GE technology also depends on a consumer's prior opinions of GE foods, if an individual is initially less accepting of GE technology, being given additional, positive information will not significantly influence their acceptance levels (Lusk et al. 2004). This is noteworthy, as it proposes individuals that have preconceived negative attitudes of GE foods will not respond as positively to new information as individuals with favorable attitudes towards GE foods. Previous literature supports these findings. Frewer, Scholdereer and Bredahl (2003) reiterate that the strength of priorly held beliefs and attitudes towards a particular technology may limit the effect new information can have in changing an individual’s attitude. They report, “a distrusted information source that is perceived to have a vested interest in promoting a particular view may increase public negativity toward a technology that it is promoting;” furthermore, this is more often the case when the information appears to be biased in favor of the entity that has the vested interest (Frewer, Scholdereer and Bredahl 2003).

Herein lies the fundamental issue with GE education efforts; consumers believe the majority of research regarding the safety of biotechnology has either been conducted or funded by biotechnology firms. It is also not unusual for consumers to believe these corporations are self-interested and profit driven. Given Frewer, Scholdereer and Bredahl’s (2003) finding, it is evident that the primary source of information may be better received and welcomed if it is coming from a trusted unbiased, third party. However, even though GE technology and crops are vetted by the USDA, FDA, and EPA, consumers are still being subjected to opposing messages propagated by consumer and environmental advocacy groups. So, even though information can mitigate aversion to GE crops as previously noted, Colson and Huffman (2011) find that “the premium consumers are willing to pay declines significantly in a crowded information environment with positive, negative, and verifiable information.”

GE labeling continues to be one of the most contentious issues in food and agricultural policy. Producers and manufacturers’ main concerns are twofold: the logistical and operational costs of compliance will likely have large monetary consequences for these firms, and because research suggests food products labeled GE are stigmatized, producers, manufacturers and retailers are worried about the potential loss of revenue due to decreased sales. However, it is worth noting that because not all food products that do contain GE ingredients currently aren’t labeled in the United States, the majority of these studies fabricate labels, similar to the image provided below:

Figure 1. Examples of Auction Food Labels for Products without Enhanced Nutrients

Russet Potatoes (5 lb.)	Russet Potatoes (5 lb.)	Russet Potatoes (5 lb.)
Enhanced levels of Antioxidants and Vitamin C	Enhanced levels of Antioxidants and Vitamin C	Enhanced levels of Antioxidants and Vitamin C
GM Product	Intragenic GM Product	Transgenic GM Product

Other examples of typical labels used in contingent valuation studies measuring consumer's WTP and WTA GE foods are provided in Appendix A and B. In reality, the GE label that will be placed on food packages will be much less obvious. Both General Mills and Campbell's have released prototypes of the label they plan on using on food products that are made with GE ingredients, as pictured below:

Because the proposed GE labels will be situated on the back of the food product below the ingredients as opposed to blatantly on the front of the packaging, it is very likely that the majority of consumers will not even notice the label. Similarly, it is reasonable to hypothesize consumers with food allergies who are accustomed to reading the ingredient list and allergen warnings will be most aware of this label. It is therefore possible that the signaling effects of GE labeling may be overestimated in these research studies.

The effect to which GE label will signal to consumers is heavily dependent on a consumer's understanding of GE technology, prior belief and perception of GE foods, and information. If a consumer is adamantly against consuming foods produced with biotechnology, new information has been shown to not likely to alter their preferences. However, the majority of shoppers may be familiar with the terms genetic engineering or biotechnology, but may not fully understand the benefits or technology.

Genetic engineering is a well-established technology that can be utilized to help achieve food security; however, whether or not the full potential of biotechnology will be fully exploited is contingent on consumer acceptance of GE foods. This thesis does not explicitly argue for or against the use of GE foods; this thesis explores how information influences consumer preferences for organic and Non-GMO certified snack products relative to their conventional counterparts, specifically to better understand if clearly stating the benefits of GE foods makes consumers less inclined to prefer more expensive organic and/or Non-GMO labeled food snacks.

III. Methods and Quantitative Framework

In this section I first outline the conceptual framework used to study my research question and my broader research goals. Next I outline the basic hypothesis to be investigated in the Results and Analysis Section, and then describe how the experimental design will answer my hypotheses. Lastly, I describe the econometric specifications used to test my hypotheses.

3.1 Conceptual Framework for Examining Consumer Acceptance of GE Foods that Reduce Food Waste

The research studies discussed above demonstrate that information influences consumer preferences for food products differentially, depending in part on individual characteristics such as socio-demographic and attitudinal factors. Furthermore, there is no consensus regarding exactly how positive information affects food preferences. I am broadly interested in contributing to the literature by examining how information and price variations influence consumer preferences for conventional snack products produced with GE ingredients, organic certified snack products, and Non-GMO verified snacks. More specifically, as GE crops continued to be developed with the intention of providing various benefits to producers and consumers alike, how consumers respond to information about these new GE varieties will be of utmost importance to developers of GE crops, producers, processors, and retailers.

As noted above, Innate Potatoes are one example of a GE crop created using 2nd generation GE technology. One potential benefit of adopting this crop is that it will reduce the amount of potato food waste resulting from natural production and processing inefficiencies. As food waste is a major environmental issue that has garnered much media attention in recent years, and given the combined efforts being undertaken by government agencies, food companies, and consumer advocacy groups to reduce to food waste, these GE varieties have the potential to greatly reduce food waste throughout the food supply chain. However, whether or not the food waste reduction benefits of GE foods will influence consumers' decisions about purchase patterns depends heavily on understanding if informing consumers of these benefits of GE foods increases consumer acceptance.

Stated choice surveys are among the most commonly used and appropriate technique to isolate how information and specific product characteristics influence preferences for food products. I therefore develop five stated discrete choice surveys, each only varying by the information treatment, to determine if and to what extent positive information about the food-waste reduction benefits of GE's influence consumer preferences. The five information scenarios constructed are: (i) a “Stigma” scenario where participants are merely informed that the less expensive conventional snack product is produced with GE ingredients, (ii) a “Scientific” scenario in which participants are provided with information on the safety of GMO foods as determined by accredited organizations, (iii) a “Food-Waste Reduction Benefit” scenario in which participants are provided with information on how GE potatoes can reduce food waste, (iii) a “Combined” scenario where participants are provided information on both the scientific safety and food waste reduction benefits of GE foods, and, (iv) a “no-information” baseline scenario. The “Stigma” scenario is used as the control group in order to control for any signaling effects. For the remainder of the paper, Treatment 1, 2, 3, and 4 refers to the “Scientific,” “Food-Waste Reduction Benefit,” “Combined,” and “no-information” scenarios, respectively. This study also collects socio-demographic, attitudinal and habitual variables for all participants to better understand how these factors affect consumer preferences for conventional, organic and Non-GMO snack foods.

Overall, this study is designed to investigate how information and price differentials influence consumer preferences by comparing how the information treatments affect the choices made between the surveys. In our analysis, we will estimate the degree to which making apparent the benefits of GE foods increases an individual’s likelihood of preferring the cheaper conventional snack product produced with GE ingredients after controlling for the difference in prices between the two products among other factors. However, in such a crowded information environment, it is expected that priorly held beliefs about GE foods and environmental sustainability will greatly influence how a consumer responds to new information. Attitudinal variables are therefore included in the analysis to better understand if positive information mitigates preconceived negative perceptions.

3.2 Outline of Hypotheses and Predictions

Below I outline the major hypotheses to be tested using the survey data. These hypotheses were developed by merging past research findings, discussed earlier in the Literature Review, with economic intuition and consumer trends. I will test these hypotheses by first assessing the summary statistics and then will more formally analyze the data using the econometric models developed later in Section 3.4.

Hypothesis 1. A small percentage of subjects in all treatment groups will prefer either the conventional Frito-Lay or *Simply* brand throughout the experiment, regardless of price differential or treatment effect; these subjects have unwavering preferences that are not influenced by new information or prices.

Hypothesis 2. Assuming consumers value the Organic and Non-GMO attributes, subjects are more likely to prefer the *Simply* variety when priced equally to the conventional Frito-Lay counterpart. This hypothesis is based off research findings that suggest consumers will pay more for organic and Non-GE food (Lusk et al. 2005).

Hypothesis 3. Assuming consumers are price sensitive but also value the Organic and Non-GMO attributes, subjects are more likely to prefer the conventional Frito-Lay brand whenever the *Simply* variety is offered at a higher price point. Specifically, subjects are the least likely to choose the *Simply* product when priced 80¢ higher than the Frito-Lay variety relative to when the *Simply* brand is only $0.30 more expensive. Thus, we expect to see positive coefficients on the 30, 50 and 80 ¢ price difference variables. We do not expect this price sensitivity to be linear.

Hypothesis 4. Based on prior research that suggests consumers find GE foods that provide consumer and environmental benefits more desirable than GE foods that only provide producer benefits (Lusk et al. 2015), a stronger preference for the conventional Frito-Lay products is expected in Treatments 2 and 3 relative to the control and Treatment 1. Hence, the treatment effects will be positive for Treatments 2 and 3, and the potato coefficient will be significant and positive as well.

Hypothesis 5. Subjects in Treatment 4, in which no-information about the conventional Frito-Lay product was given, will display the greatest frequency of participants choosing the conventional Frito-Lay product because there is no signaling effect influencing preferences (Costanigro and Lusk 2014).

Hypothesis 6. OCOF's will be more price sensitive and receptive to the information treatments, displaying an even greater propensity to prefer the conventional Frito-Lay product in Treatment 1, 2, and 3 relative to the control group (Hughner et al. 2007). OCOF's in Treatment 4 will still be the most likely to choose the conventional Frito-Lay product across all price differences.

Hypothesis 7. We do not expect to see significant positive treatment effects among consumers that have somewhat or very unfavorable views of GE foods, as past research suggests preconceived opinions are an important determinant in a consumer's preference for non-GE foods (Baker and Burnham 2001). Lusk et al. (2004) also reiterate that providing positive information to individuals originally less accepting of GE technology will not significantly alter their acceptance or willingness to consume GE foods.

Hypothesis 8. We expect to see small positive treatment effects among consumers that have neutral views of GE foods, although we once again hypothesize Treatment 4 (the no information group) is the most likely to prefer the conventional Frito-Lay brand relative to the *Simply* version. However, Frewer, Scholdereer and Bredahl (2003) warn that priorly held beliefs may inhibit the ability of new information to drastically alter preferences, suggesting those with neutral views may be more sensitive to price than information.

Hypothesis 9. Among consumers that have somewhat or very favorable views of GE foods, all treatment effects will be positive, although Treatments 2 and 3 will have the greatest impact on increasing preferences for the conventional Frito-Lay product relative to those with neutral or unfavorable views. This hypothesis supports the research by Baker and Burnham's (2001) that find that consumers who already believed genetic engineering enhanced food quality or safety were more likely to be accepting of GE foods.

3.3 Experimental Design

Each discrete choice survey contains five choice sets. Within each choice set, research participants are presented two versions of a food product: a conventional Frito-Lay brand, and the *Simply* version of that same brand, the packaging of which features attributes and certifications such as the USDA's Organic label, the Non-GMO project label, or both. Subjects are asked to choose between these two versions of the same product seven times as the price is varied, so that the *Simply* version is either 30, 50, or 80¢ s more expensive than the conventional Frito-Lay alternative. Additionally, for one question in each choice set, the prices for the two products are the same, and the actual monetary value presented is randomly selected. The order of the choice sets and the order in which the two products were presented are randomized.

The five Frito-Lay and *Simply* brands used in each of the choice sets are Lays, Wavy, Ruffles, Tostitos Originals and Tostitos Scoops. The two *Simply* Tostito corn-products contain both the Organic and Non-GMO label, *Simply* Wavy potato chips are USDA organic certified, and the *Simply* Lays and *Simply* Ruffles potato chips bear the Non-GMO project label. Because the second and third information treatments inform participants of the food waste reduction benefits of GE potatoes, potato and corn chip products are used in the survey to determine if subjects have differing preferences for organic, Non-GMO or conventional potato chips relative to corn chips. I hypothesize that consumers are more likely to choose the conventional Frito-Lay potato chips relative to the corn chips because of the highlighted environmental benefits of GE potatoes. After participants complete the five choice sets, they are asked a series of questions regarding socio-demographic factors, food-purchasing habits, and attitudinal statements related to their prior beliefs of GE foods and food waste. A screenshot of a choice question and the full questionnaire can be found in Appendix Z.

The design of the experiment rests on the assumption that consumers have preferences that are subject to change based on the price of complementary goods and upon being presented additional information. Someone with strong preferences for organic and non-GMO options will prefer the *Simply* product relative to the conventional version regardless of the price differential and any information given. On the other end of the spectrum, some subjects may not care for purchasing organic or Non-GMO products, and will always opt for less expensive, conventional Frito Lays product. However, consumers with less defined preferences that purchase organic sometimes depending on the price at which complimentary products are being offered will be greater influenced by the relative prices, surpluses and information treatments.

Consumers also use visible cues, such as packaging and labels, to infer product quality and form expectations based on these cues (CAST 2015). As thoroughly described in the literature review, consumers may change their food product preferences if they believe some food product attributes provide additional benefits, such as enhanced nutritional value or environmental sustainability. Similarly, consumers may opt to avoid certain products due to perceived negative externalities resulting from a product's attributes. This study was developed to better understand if, how, and to what extent positive information about a food product's attributes influences consumer preferences for snack products.

Using an online survey platform, participants were randomly assigned to participate in one of the five information treatments, as described in the previous section. For the no-information treatment group, participants proceeded directly to the choice sets after agreeing to take part in the survey. For the four information treatments, participants were asked to read a statement before answering the choice sets. Our control group was merely informed that the less expensive conventional Frito-Lay product was produced with genetically engineered ingredients. The first information group read a statement reaffirming the established safety of GE ingredients as verified by the National Academies of Sciences, Engineering and Medicine. The second positive information group read a paragraph detailing the food-waste reduction benefits of GE potatoes. The third information treatment specifies both the verified safety of GE crops and outlines the food-waste reduction benefits of GE potatoes. I hypothesize the third positive information treatment will have the strongest effect on influencing consumers to prefer to less-expensive Frito-Lay snack product produced with GE ingredients. The exact wording of the information treatments can be found in Appendix B (doc "treatments").

To ensure the pools of respondents are nationally representative, subjects were required to enter the gender with which they most identify, their age, and the region in which they currently reside. Participants were also asked if they always, frequently, sometimes, or never purchased food for their households; those that responded never were disqualified from participating in the survey. This was done to maximize the likelihood that respondents were not only familiar with the snack products presented in the choice sets, but also acquainted with the organic and Non-GMO label. To further ensure subjects were responding thoughtfully and carefully throughout the survey, two attention-check questions were embedded in the survey, which prohibited participants from blindly selecting answers. After the third choice set, participants were presented a slider scale and were asked to move the bar to the number 7. If participants did not correctly complete this task, they were immediately terminated from further participating in the survey. In the middle of the post choice-set questionnaire, one question in a matrix block merely asked subjects to click the "Very Rarely" box. Once again, participants that answered otherwise were no longer eligible to participate and their responses were discarded. Furthermore, each of the five surveys underwent a soft launch in which 10 responses were collected prior to the survey being fully released. A speed-check was installed into the full launch of the survey, which automatically terminated subjects that answered in less than one-third the median soft launch time. These two attention check questions and the speed-check help validate the survey responses by ensuring respondents answered thoughtfully.

Although not incentive compatible, stated discrete choice surveys are the most appropriate and widely used tool to uncover consumer food preferences in hypothetical scenarios. However, given that the respondents self-report their preferences and I do not have data on their actual purchasing behavior, the main concern of the survey design is social desirability bias. Broadly speaking, social desirability bias is the tendency for individuals to attempt to express themselves favorably, whether by fabricating or conforming to standards believed to be the correct or better option (Maccoby and Maccoby, 1954). Self-reported responses in hypothetical scenarios may therefore not be representative of the actual preferences individuals' hold, the result potentially being, "data that are systematically biased towards respondents' perceptions of what is 'correct' or socially acceptable" (Fisher, 1993). However, given that participants completed the survey in the privacy of their own homes, it is unlikely that this data are systematically or significantly skewed, as individuals have no basis to fabricate their preferences.

3.4 Random Utility Theory, Logit and Mixed Logit Model

To model consumer preferences for conventional Frito-Lay snack products relative to the *Simply* version counterparts, I employ a random utility framework. The basic intuition behind the Random Utility Model (RUM) is that when a decision maker makes a choice between multiple alternatives in a choice situation, the agent will consider the tradeoffs between the alternatives and choose the alternative that provides the highest level of utility. The random utility theory is the appropriate framework to conceptualize the results of this stated discrete choice survey because people receive varying levels of utility based on their food choices. Some shoppers receive high levels of utility from consuming organic or Non-GMO certified foods due to the perceived and/or real benefits derived from the production and/or consumption of these products; these strong preferences are observable in our study. As previously defined by the literature, regular consumers of organic foods (RCOF) are nutritionally conscious, value the healthfulness, safety, quality and taste of food, and are often associated with environmentalism, alternative lifestyles, and having greater concerns for animal welfare (Hughner et al. 2007). I define RCOF's in this sample as those that chose the *Simply* branded product over the conventional Frito-Lay variety, regardless of price or information provided, in all thirty-five choice questions. Even when informed of the potential of GE potatoes to significantly reduce food-waste, RCOF's had unwavering preferences. In this study I classify those that always opted for the *Simply* version, regardless of the price differential, as RCOF's. In one part of the analysis, I omit RCOF's as well as subjects that always preferred the conventional Frito-Lay product. I assume that subjects that always opted for the conventional

Frito-Lay variety, even when the *Simply* product was priced equally, receive no utility from the attributes of the *Simply* versions, namely Non-GMO or USDA organic certification. By omitting these two groups of participants, we are better able to understand the preferences of subjects we label the occasional consumer of organic food (OCOF). OCOF's buy conventional, organic and Non-GMO labeled food, with preferences and purchasing decisions often depending on the price of complementary goods, extractable surplus, and the availability of information, among other factors. While we cannot observe all of the variables that affect the respondents' choices, the price differential between the two products and information treatments are the two variables of greatest interest in this study.

In the survey, participants are presented with five distinct choice sets in which they state their preference for either the conventional Frito-Lay or *Simply* variety. Following Lancaster (1971), for alternative j and individual i the deterministic component of utility, V_{ij}, is written as a linear combination of the product attributes. Following McFadden (1973), overall utility respondent i accrues from product j can be written as:

$$U_{ijt} = V_{ijt} + \epsilon_{ij}$$

where $j \in \{c, s\}$ denotes whether the product is conventional or *Simply*, and ϵ_{ij} is an independent and identically distributed (IID) Type 1 extreme value error with scale parameter λ. Given this framework, consumers will choose the conventional Frito-Lay product over the Simply if:

$$\begin{aligned} P_{iCt} &= Pr(U_{iCt} > U_{iSt}) \\ &= Pr(V_{iCt} + \epsilon_{iC} > V_{iSt} + \epsilon_{iS}) \\ &= Pr(V_{iCt} - V_{iSt} > \epsilon_{iSt} - \epsilon_{iCs}) \end{aligned}$$

where the individual subscript is suppressed for notation convenience. As ϵ_j follows a type 1 extreme value distribution, the difference between these errors, $\epsilon_{iSt} - \epsilon_{iCt}$, follows a logistic distribution (cite 1973a). Therefore, the logit probability the choosing the conventional product is given by the standard logistic formula:

$$P_{iCt} = \frac{e^{V_C/\lambda}}{e^{V_c/\lambda} + e^{V_s/\lambda}}$$

Recall V_j is a linear combination of product attributes where the observation level is $i = 1 \dots 388$ and the trial level $t = 1 \dots 35$:

$$V_{ijt} = \beta X_j' - \alpha p_{ijt} + \delta_j T_i + \gamma_j D_i'$$

where X_j are the characteristics of the product, p_{ijt} is the price difference, T_i indicates the treatment group randomly assigned to individual i, and D_i' is a vector of individual specific socio-demographic variables. Therefore the log odds of choosing the conventional alternative can then be given as:

$$\ln\left[\frac{P_{ict}}{1 - P_{ict}}\right] = [V_{ict} - V_{ist}]$$

$$= X_c'\beta - \alpha p_{ict} + \delta_c T_i + \gamma_c D_i - X_s'\beta + \alpha p_{ist} - \delta_s T_i - \gamma_s D_i$$

$$= (X_c - X_s)'\beta - \alpha(p_{ict} - p_{ist}) + (\delta_c - \delta_s)\, T_i + (\delta_c - \delta_S) D_i$$

Both δ_s and γ_s are normalized to 0 because there is no individual variation within treatment, so the treatment effects are interpreted relative to the *Simply*. The Frito-Lay products were specifically chosen so that the majority of these characteristics are the same for these two products except in Organic (org) and Non-GMO ($nongmo$) status. Two of the five Frito-Lay products are corn-based, and three of products are potato-based. By construction, no conventional products can be Organic or Non-GMO certified. However, both of the corn-based *Simply* products are both Organic and Non-GMO. One of the potato chips is Organic and two are Non-GMO. This model therefore also includes a dummy intercept specifying whether the snack product was potato-based relative to corn-based and an indicator variable identifying whether the potato product was Non-GMO certified relative to USDA Organic certified. The above then simplifies to:

$$\ln\left[\frac{P_{ict}}{1- P_{ict}}\right] = \beta_0 + \beta_1 potato_{ijt} + \beta_2 nongmo_{ijt} * potato_{ijt} + \alpha(p_{ict} - p_{ist}) + \delta_c T_i + \gamma_c D_i'$$

where $potato$ is an indicator variable specifying if the food product is potato relative to corn-based and $nongmo * potato$ indicates if the *Simply* potato product is Non-GMO relative to Organic. β_1 acts as an intercept dummy, capturing how much less likely consumers are to choose the conventional potato product relative to the *Simply* potato product, and $\beta_2$measures how much less likely subjects are to prefer the conventional when the *Simply* potato-chip is Non-GMO relative to Organic. β_0 captures how much more likely consumers are to choose the conventional Frito-Lay product relatively to the *Simply* variety purely due to the branding effect. As previously noted, $\alpha(p_c - p_s)$ estimates the influence of the price differential on an individual's likelihood of choosing the conventional product relative to the more-expensive *Simply* counterpart.

Given the above expression for P_{ict}, the log-likelihood function can be written as:

$$LL(\theta; y, Z) = \sum_i \sum_t (y_{it} p_{ict} + (1 - y_{it})(1 - p_{ict}))$$

where y_{it} is an binary dependent variable = $\begin{cases} 1 \ if \ the \ respondent \ chose \ Conven \\ 0 \ if \ the \ respondent \ chose \ Simply \end{cases}$,

$\theta = [\beta, \alpha, \delta, \gamma]$, and Z is the corresponding data. The above likelihood function is maximized with respect to θ.

The logit model is the mostly widely utilized tool for analyzing results of stated discrete choice surveys. However, the standard logit model poses many limitations that inhibit the ability of the model to properly account for preference heterogeneity. The three most significant limitations are as follows: (i) logit models assume homogeneity of preferences and it is difficult to account for preference heterogeneity within the data, an assumption easily violated, (ii) logit models do not account for the fact that in stated choice surveys, each individual is presented a number of choice sets in which multiple decisions are made, and (iii) logit models assume a constant error variance across all alternatives, or most commonly referred to as the IID assumption.

Alterations to the logit model can be made to address the first two limitations. Preference heterogeneity can be integrated in the model by including interaction terms between product attributes and individual characteristics, which is tedious. The second limitation regarding multiple responses per subject can be addressed by clustering standard errors at the individual level, or standard errors can be bootstrapped; however, these techniques are not sufficient in an of themselves. The main limit of the logit model is it restricts preferences, a constraint that can only be addressed by exploring other models.

There are three main benefits to using the mixed logit model over the standard logit model: (i) the mixed logit model allows for preference heterogeneity, (ii) the mixed logit model accounts for correlation across repeated choice set observations for each individual, and (iii) the mixed logit model relaxes the IID assumption by allowing for non-constant error variances across alternatives. Given the design of our experiment, it is reasonable to assume that consumers have different price sensitivities and diverse preferences for food products and that the choices individuals made across the thirty-five choice sets are correlated.

The mixed logit model incorporates preference heterogeneity by allowing the beta to vary by individual. As specified before, the overall utility U individual i receives from choosing alternative j is as follows:

$$U_{ijt} = V_{ijt} + \epsilon_{ij}$$

V_{ij} is once again a vector of observable product attributes and socio-demographic variables, written as:

$$V_{ijt} = \beta X_j' - \alpha_i p_{ijt} + \delta_j T_i + \gamma_j D_i'$$

whereas the main difference is that α_i measures how sensitive subjects are to varying levels of price differentiation between the conventional and *Simply* products. I assume α_i follows a normal distribution following mean a and variance σ_a^2. Whereas most literature calls this individual-specific α_i estimate a "taste parameter," I refer to this coefficient as a price-sensitivity parameter. Consumers differ greatly in their price sensitivity, especially for food products, depending on the products attributes. Evidence for this is seen by consumer choices in actual markets; many times people will purchase the conventional option because it is cheaper, but may switch their preference to the organic or Non-GMO version depending on the price at which the counterpart is offered. Some consumers will purchase organic and Non-GMO products regardless of the price at which these products are offered – these consumers are referred to as RCOF's. Alternatively, there are those that rarely or never purchase organic and Non-GMO food for one of two reasons: either they don't value these attributes, or they ares unaware of the benefits organic and Non-GMO production bring, whether that is better quality, taste, or more sustainable agricultural production. FOOTNOTE: I attempt to apply random parameters to the treatment dummy variables, but am not able to due computational limits.

The deterministic component of utility can therefore be written as:

$$V_{ijt} = \underbrace{X_j'\beta + \delta_j T_i + \gamma_j D_i' -}_{=\Gamma_{ij} W_{ij}} (a + \mu_i \sigma_\alpha) p_{ijt}$$

The parameter coefficient on the price difference variable has been split into a deterministic component, α, and a random component $\mu_i \sigma_{\alpha_i}$, where μ_i is assumed to follow a standard normal distribution. The mixed logit choice probabilities can then be found by integrating out the random component of the conditional choice probabilities:

$$P_{ic} = \int \left(\frac{e^{V_{ict}}}{e^{V_{ict}} + e^{V_{ist}}} \right) \phi(\mu)\, d(\mu)$$

where $\phi(\mu)$ is a normally distributed density function. This mixed logit choice probability is essentially the same as the logit choice probability except in the fact α_i varies by individual in the mixed logit whereas α is fixed across all individuals in the standard logit model. While this integral does not have a closed form expression, it can be approximated using Monte Carlo simulation methods. Specifically, by taking R draws from μ_i's distribution to form a sample $\{\mu^r\}_{r=1}^{R}$. The simulated probability is then

$$\widetilde{P_{ic}} = \frac{1}{R} \sum_{r=1}^{R} \frac{exp(\Gamma_c W_{ic} - \alpha\, p_{ic} - \mu^r \alpha_a p_{ic})}{exp(\Gamma_c W_{ic} - a\, p_{ic} - \mu^r \sigma_a p_{ic}) + exp(\Gamma_s W_{is} - a\, p_{is} - \mu^r \sigma_a p_{is})}$$

Maximum likelihood estimation is then employed to find the point estimate,

$$LL(\theta; y_{it}, Z_{it}) = \sum_i \sum_t (y_{it} \widetilde{P_{ic}} + (1 - y_{it})(1 - \widetilde{P_{ic}}))$$

where the vector of parameters to be estimated is $\theta = (\beta, \delta, \gamma, a, \sigma_a)$. The maximum simulation likelihood estimator is then simply,

$$\hat{\theta} = \underset{\theta}{\operatorname{argmax}}\ LL(\theta; y_{it}, Z_{it})$$

While the mixed logit model is more likely the appropriate estimation strategy compared to the standard logit model for this survey data, the results of both logit and mixed logit specifications are contrasted in the Results section.

IV. Data

4.1 Description of Data: Summary Statistics

Using an online survey platform, a total of 388 survey responses were collected from a nationally representative sample in terms of gender, age, and region. Each treatment contains responses from at least 75 participants; the third treatment's sample size is the greatest, with 80 respondents. Subjects were only eligible to take part in this survey if they responded that they sometimes, frequently or always purchased food for their household. We also collected socio-demographic characteristics, food purchasing behaviors, and attitudes towards GE foods, all of which are utilized in the analysis. Table 4.1 at the end of this section defines all variables and self-reported measurements. Table 4.2 provides summary statistics of the participants' socio-demographic characteristics by treatment group. Information regarding food purchasing behavior and attitudes towards GE foods are provided in Table 4.3 and 4.4, respectively.

An analysis of variance (ANOVA) test was conducted to ensure that no significant differences exist between the control and treatments groups in terms of socio-demographic variables including age, education level, incomes, and ethnicities. While the results of this ANOVA test do not find meaningful differences, the underlying regression coefficients (from the *regress, baselevels* command) do suggest that the third treatment group may have somewhat lower levels of education ($p<0.10$) relative to the control group; high school was the highest level of education received by 38% of subjects in treatment 3 received, compared to the overall survey average of 25%. An ANOVA test was also conducted to determine if the control and treatment groups contrasted significantly in terms of their understanding and views of GE foods. Overall the ANOVA tests once again confirmed no significant differences exist between the control and treatment groups in terms of GE understanding, view, and whether participants in these groups believed GE foods were a threat to human health. Looking at the underlying parameter estimates, Treatment 2 ($p<0.05$) and Treatments 1 and 3 ($p<0.10$) had slightly more neutral or favorable views of GE food relative to the control group. Participants in Treatments 2 and 3 also indicated they had a slightly better understanding of GE foods on average than the control group, findings of which are evident in the GE attitude table (Table 2) in the Appendix.

I also conducted these same ANOVA tests after omitting participants that always choose either the conventional Frito-Lay or *Simply* variety throughout the entire experiment. This analysis is done to ensure that the results of models 6 and 7, reported in Tables 5.2.1 and 5.2.2, are valid. The results of these ANOVA tests confirm there are no significant differences between OCOF's in control and treatment groups in terms of age, marital status, ethnicity, income, or education levels. However, there is a significant difference in terms of how these participants view GE food. Overwhelmingly, OCOF's in Treatments 1 and 2 have more favorable views of GE foods than the third and fourth treatment groups, relative to the control group ($p<0.01$). Treatment 2 has the largest percentage of respondents with a somewhat favorable view of GE foods compared to the other groups, and they also report having a better understanding of GE technology than the other groups as well, however this estimate is only significant at the ($p<0.10$) level. Because these self-reported attitudinal questions were posed to subjects in the post-survey questionnaire, I cannot determine how the treatments may have anchored or influenced subjects to shift prior opinions. Nevertheless, it will be important to take these differences into consideration in the analysis.

4.2 Description of Choices

To understand the overall distribution of preferences, Figures 4.1, 4.2, and 4.3 detail the aggregate percentage of all respondent choices across treatments and price differentials. Please note that as previously described in section 3.2, participants in the control group were informed that the less expensive conventional snack product was produced with GE ingredients, Treatment 1 refers to the "Scientific" scenario, Treatment 2 refers to the "Food-Waste Reduction Benefit" scenario, Treatment 3 refers to the "Combined" scenario, and Treatment 4 is the no-information scenario.

Figure 4.1 details the overall percent of times that respondents choose the conventional relative to the *Simply* Frito-Lay products across treatments. It is worth noting that in the third treatment group, respondents choose the conventional and *Simply* products nearly equally. Because this sample received positive information regarding both the scientific safety of GE crops and food-waste reduction benefits of GE potatoes, the fact that preferences were near split is quite unusual. I expected that given the stated benefits of the GE ingredients used in the conventional Frito-Lay product, consumers would be more price sensitive and less likely to choose the more-expensive *Simply* product. The greatest difference in preferences is seen in Treatment 4, where no information was given. Participants in this treatment group were the most likely to choose the conventional Frito-Lay product relative to the other treatments. Participants in this group were not informed that the conventional Frito-Lay products were partially produced with GE ingredients, so this result suggests there was no signaling effect or stigmatism influencing preferences. This reiterates past research findings discussed in the literature review; merely stating that a product contains GE ingredients decreases the willingness of a consumer to prefer, buy and consume that product.

Figure 4.2 illustrates the frequency of times all subjects, regardless of treatment group, choose the conventional Frito-Lay product across price differentials. When the conventional and *Simply* products were priced equally (i.e. when the price differential was 0 ¢), only 38.1% chose the conventional Frito-Lay variety. The large majority of respondents, regardless of information treatment, preferred the *Simply* variety when the two products were offered at the same price point. However, we cannot definitively conclude whether this strong preference for the *Simply* products is attributable to a subject's desire to avoid GE ingredients or realize the benefits of organic or Non-GMO food. However, even when we drop the no-information group from the analysis, still only 38.1% opt for the conventional product, suggesting that even when no information about the ingredient make-up is given, the majority of subjects still prefer the *Simply* version. When the *Simply* product is 30, 50 and 80¢ s more expensive, subjects preferred the conventional Frito-Lay product 55.3%, 61.2%, 64.7% of the time, respectively. We expected to see a larger difference between the 30 and 80¢ price differences, given that the majority of subjects did prefer the *Simply* brand when it was equally priced, but even an increase of 30¢ s made the conventional Frito-Lay product the more attractive option to the small majority of subjects. When the *Simply* product was 80¢ s more expensive, 35.3% of total subjects reported preferences for that version.

Figure 4.3 displays the total frequency of trials in which the conventional Frito-Lay product is chosen across treatments and price differentials. As observed in Figure 4.1, Treatment 4 is the most likely to prefer the conventional to the *Simply* version whenever the *Simply* product is more expensive, while subjects in Treatments 2 and 3 are the least likely to opt for the conventional variety.

To better understand the distribution of preferences specifically among subjects whose product choices varied throughout the choice survey, I recreate Figures 1-3 omitting participants that only chose the conventional or *Simply* variety in all 35 choice questions; these figures are labeled 4.1a, 4.2a, and 4.3a in the Appendix. These participants with varying preferences can be classified as occasional consumers of organic food (OCOF). While 13% of these OCOF's respond never purchasing organic or Non-GMO products, these participants did indicate a preference for the *Simply* variety in a number of choice scenarios. Therefore, for simplicity, I argue these subjects can still be classified as OCOF's. By omitting participants that did not vary their responses across all 35 choice questions, we are better able to understand how the information treatments and price differences influenced preferences. The greatest difference observed when comparing Figure 4.3 and 4.3a is that OCOF's are more likely to prefer the *Simply* product when priced equally to the conventional, although they are more price sensitive in trials where the conventional Frito-Lay is cheaper than the *Simply* version. Similar to the entire sample population, OCOF's in Treatments 2 and 3 are the least likely out of all subsamples to prefer the conventional across price differences.

To better understand the influence of demographic variables on preferences, I segment subjects by education and income. Among individuals with at least some college education, subjects preferred the conventional Frito-Lay product 36.5% of the time when prices were equal, which is very similar to the estimate obtained when all subjects were included. Similarly, when the *Simply* product is priced 30, 50 and 80¢ s higher, subjects preferred the conventional version 55.2%, 61%, and 65.7% of the time, respectively. This indicates that education may not be a significant factor in determining preferences for conventional and organic or Non-GMO food. Subjects with a reported household income of greater than $75,000 preferred the conventional version in only 30.9% of the trials when the two products were priced equally, whereas the Simply version is preferred 56%, 47.2%, and 41.6% of the time when the *Simply* product is priced 30, 50 and 80¢ higher. Across all price differences, it is evident that individuals in higher income brackets have a stronger preference for the *Simply* branded products relative to the conventional Frito-Lay version. While it is not surprising that higher-income individuals are not as price sensitive, we cannot deterministically attribute this preference to a desire to avoid GE ingredients. This preference may also be a function of a perceived, or real, difference in quality, nutrition, or environmental and health factors between the two products. These variables and other attitudinal factors' contribution to preferences will be more formally analyzed in Section 5.

Lastly, I isolate the corn and potato products and compare the percent of times the conventional potato chips were preferred to the percent of times the conventional corn chip products were chosen in Figures 4.4 and 4.5, respectively. Comparing the figures, we see that conventional corn chips were chosen more often in terms of percentages than the conventional potato chips. The differences appear to be greatest for the control group and treatment 1, but less pronounced for treatments 2 and 3. This conflicts with what we hypothesized, give that subjects were informed of the food-waste reduction benefits of potatoes in the second and third treatment. We therefore expected subjects in Treatments 2 and 3 to prefer the conventional potato chips more than they preferred the conventional corn chips, although this does not appear to be the case.

V. Results and Analysis

In this section, I will first briefly describe how the specifications were implemented before presenting, analyzing, and discussing the results of the mixed logit models. I run logit and mixed logit models on five different segments of participants: (i) all participants, (ii) participants that had varying responses across the five choice sets, namely I omit RCOF's and subjects that only choose the conventional Frito-Lay throughout the choice survey, (iii) participants that have favorable views of GE foods, (iv) participants that have neutral views of GE foods, and (v) participants that have unfavorable views of GE foods. In each of these sections, I provide justification and context for segmenting the subjects as such. Please note the results of the logit models can be found in the appendix, but I do not discuss those results for the mixed logit is the more appropriate model given the heterogeneous preferences assumptions outlined in the methodology section.

In total I report 8 models, and for each model, I run 4 separate specifications: (i) a standard logit without interaction terms, (ii) a mixed logit without interaction terms, (iii) a standard logit with an interaction term between the treatment and either the price difference or GE view terms, and (iv) a mixed logit with an interaction term between the treatment and either the price difference or GE view terms. Interacting price difference with treatment is key to the analysis, as I earlier hypothesized (*H4*) that the positive information treatments will make participants more price sensitive and more likely to prefer the conventional product over the *Simply* version. Interacting treatment with GE view enables us to gauge how the treatment effects may differ between subjects with varying views of GE foods. The specifications with interaction terms will be identified as Logit 1a and Mixed Logit 1a, for example.

In all models presented below, the control group and *price_diff_0* are omitted to avoid multicollinearity issues. The results are henceforth interpreted relative to the control group and relative to when the conventional Frito-Lay and corresponding *Simply* version were priced equally. Furthermore, the standard errors are always clustered robust at the individual level to control for correlation among an individual's error structure.

In the mixed logit models, random parameters are imposed on the price difference variables. Across every mixed logit model, the random coefficients are statistically significant at the $p<0.01$ confidence level, suggesting that preference heterogeneity exists among our participants; specifically, we find heterogeneous price sensitivity among subjects, suggesting that participants responded to the various surpluses differently. This finding was expected, as food preferences vary widely across individuals depending on the product attributes and prices; these findings will be further examined in the Discussion section.

5.1 Analysis Including All Participants

In Tables 5.1.1-5.1.3, all survey participants are included in the analysis; this includes subjects that always opted for the conventional Frito-Lay product (n=65), those that always preferred the *Simply* brand (n=61), and subjects that displayed varying preferences depending on the price at which the products were offered.

5.1.1 Base Model: Table 5.1.1

The most parsimonious mixed logit specification includes the price differences and treatments as independent variables, as well as two indicator variables specifying if the snack product is potato-based relative to corn-based, and whether the potato snack product is Non-GMO certified. The specifications reported in this section are:

$$\ln\left[\frac{P_{ict}}{1-P_{ict}}\right] = \beta_0 + \beta\, ATTRIBUTES_c{}' - \alpha\, PRICEDIFF_{iCt} + \delta_j\, TREATMENT_i$$

where $PRICEDIFF_{ijt}$ indicates $PRICEDIFF\_30$, $PRICEDIFF\_50$, or $PRICEDIFF\_80$ depending on the trial, $TREATMENT_i$ indicates to which treatment the subject belongs, and $ATTRIBUTES$ is a vector including $potato$ and $nongmo * potato$. It is important to note that the two *Simply* Tostito corn-products contain both the organic and Non-GMO labels. The $nongmo * potato$ indicator variable is included to investigate if preferences vary between the Non-GMO and organic attributes solely among the potato chip products. For the remainder of the paper, this specification is referred to as the base model.

Across all models, the 30¢, 50¢, and 80¢ price difference variables are all positive and statistically significant at the 99% confidence level, confirming *H3* that subjects are more likely to prefer the less expensive conventional Frito-Lay product in all instances where the *Simply* version is more expensive. Although parameter coefficients estimated from logistic regressions are not usually interpretable, it is worth noting that the coefficient on the 80¢ price difference variable is greater than the parameter estimate for 50¢ price difference, which is in turn greater than the 30¢ price difference estimate. This indicates a natural ordering, and as described in the summary statistics section, the magnitude of the price difference does influence consumers differentially; the greater the price difference between the conventional and *Simply* product, the more likely participants are to choose the cheaper conventional product. These results are in order with *H3* and demonstrate that subjects did consider the prices of the products when choosing which product they preferred.

However, no treatment variables are significant, rejecting *H4* that hypothesizes receiving positive information on the various benefits of GE foods would increase the incidence of subjects choosing the conventional option. Collectively these results lead me to reject *H4,* which states subjects in the positive information treatment groups would be more inclined to prefer the conventional Frito-Lay product relative to the *Simply* version. These null results are suggestive of a few possibilities: (i) the positive information treatments did not alter consumers preconceived preferences, (ii) subjects may not have been reading the information treatments carefully, or (iii) there may be a signaling effect at play, in that informing consumers that the conventional Frito-Lay product was produced with GE ingredients may have stigmatized those products. These possibilities among others are discussed throughout the remainder of the paper.

With three exceptions, I also do not find broad statistical significance when price differences are interacted with the four treatment variables. In Mixed Logit 1a, the interaction term between the 30¢ price difference and Treatment 1 is negative and significant at the $p<0.05$ level, suggesting that among participants in the scientific treatment group, subjects were less likely to prefer the cheaper conventional Frito-Lay product when the *Simply* version was only 30¢ more expensive. In Mixed Logit 1a, I find that subjects in the second food-waste treatment group were less likely to opt for the conventional Frito-Lay product when there was an 80¢ price difference between the two products; however, this effect is only significant at the 90% confidence level. This result is counter to the most basic economic intuition and because I do not find significance among the other interaction terms including treatment 2, I do not further elaborate on the substance of this finding.

The parameter estimate on the potato variable is negative and highly statistically significant at the 99% confidence level across all four models. This result implies that relative to the Tostito corn chips, subjects were overall much more likely to opt for *Simply* potato chips when choosing between *Simply* and conventional Frito-Lay potato chips. This result strongly rejects *H4*, which contends that the food-waste benefits of potatoes will encourage participants to prefer the conventional Frito-Lay brand to the *Simply*. Of the three potato chip products, only the *Simply* Wavy chips are USDA organic certified, and the *Simply* Lays and *Simply* Ruffles packages bear the Non-GMO project label. The Non-GMO potato interaction term is negative and significant at the $p<0.10$ level, suggesting that among the potato chip choice sets, subjects were more likely to choose the *Simply* versions that were Non-GMO verified relative to the organic potato chips.

5.1.2 Base Models with Socio-Demographic Characteristics: Table 5.1.2

Next I add a few key socio-demographic variables to the base models presented in section 5.1.1 to help control for the variation in how these factors influence food attribute preferences:

$$\ln\left[\frac{P_{ict}}{1-P_{ict}}\right] = \beta_0 + \beta\, ATTRIBUTES_c' - \alpha\, PRICEDIFF_{iCt} + \delta_j\, TREATMENT_i + \gamma_j D_i'$$

where D' is a vector of the variables: age, age^2, $female$, $married.domesticpartner$, $other.relationship$, $ethnicity$, $income$, and $educ$. Age is included as both a continuous variable and a quadratic squared term. $Female$ is included as an indicator variable. Adding the two binary variables $married.domesticpartner$ and $other.relationship$ controls for how the subject's relationship status may influence preferences, while the variable $single$ is omitted to avoid multicollinearity. $Ethnicity$ is included as a categorical variable to account for how race how differentially influence preferences for conventional, organic and Non-GMO food. The level of education an individual received is also controlled for in the regressions by the $educ$ variable; in the analysis, results are interpreted relative to subjects that have a high school degree or less. Lastly, I include $income$ in the model, as research suggests those in higher income brackets are more likely to prefer organic and Non-GMO food. These results are interpreted relative to subjects whose yearly household earnings are less than $25,000.

In Table 5.1.2, all price difference terms are positive and increase as the cent difference becomes greater, as *H3* presumes, and all coefficients are significant at the $p<0.01$ level. Treatment 3 in Mixed Logit 2 is now negative and significant at 95%, suggesting participants in the third (positive) treatment group were less likely to choose the conventional Frito-Lay product than subjects only informed that the conventional Frito-Lay product was produced with GE ingredients. This is the opposite of the effect we expected, and rejects the theory laid out in *H4*. The signs and significances of the price difference treatment interaction terms are the same as reported in Table 5.1.1.

Many of the socio-demographic control variables are also significant. Age is negative and statistically significant at the 99% confidence level in the mixed logits and 95% in the logits, and age^2 is also 99% significant but positive, suggesting that while the propensity to prefer the *Simply* products increases with age, after a certain age people become more likely to choose the less expensive conventional counterpart. In both mixed logit models, female is negative and statistically significant at the $p<0.10$ level; however, this slight gender effect is diluted in later regressions. Subjects that are either divorced, separated or widowed appear to be more likely to prefer the *Simply* versions relative to those that report being single, although this subpopulation of people account for 15% of total respondents, so not much weight is placed on this result.

When considering income effects, it's worth noting that the majority of participants reported earning between $25-75,000 yearly. The negative and statistically significant ($p<0.05$) estimate on income suggests all individuals that reported household incomes over $25,000 were more likely to choose the *Simply* variety than subjects earning less than $25,000. Regarding the influence of education level on food attribute preferences, both mixed logit models generate negative and statistically significant ($p<0.05$) estimates suggesting that those with higher education levels have stronger preferences for the organic and Non-GMO attributes. This is counter to the logic that consumers with greater intellectual abilities should be better equipped to understand the risks and benefits of GE technology, and therefore more likely to prefer conventional food products relative to their more expensive organic or Non-GMO counterparts. However, in our survey those with higher education levels may prefer the *Simply* products for other unobservable attributes, such as perceived better taste or nutritional quality. In many markets, higher prices translate to higher quality; this same effect could be obfuscating food attribute preferences. Because all *Simply* versions have higher price points than their conventional counterparts, this may signal that the *Simply* products are of higher quality. A higher price could also potentially lead consumers to believe these products deliver other unobservable benefits; for example, increased nutritional content, lower levels of saturated fat, reduced pesticide residue. For example, a consumer might prefer organic or Non-GMO foods. In reality, Non-GMO and organic products are often priced at a premium due to the increased costs of production, which farmers and distributors pass along to consumers. Overall, because we do not see widespread or consistent education effects, these results may only be suggestive but potentially worth exploring in future studies.

5.1.3 Base Model with Self-Reported GE Attitudinal Factors: Table 5.1.3

The models presented in Table 5.3 include all the socio-demographic variables above as well as additional self-reported attitudinal variables. The specification is:

$$\ln\left[\frac{P_{ict}}{1-\ P_{ict}}\right] = \ \beta_0 + \ \ \beta\ ATTRIBUTES'_c - \alpha\ PRICEDIFF_{iCt}$$

$$+\ \delta_j\ TREATMENT_i + \ \gamma_j D'_i\ +\ \omega_j GE_i{}'$$

where GE' is a vector that includes the variables $avoid.GE$, $GE.view$, $GE.understanding$, and $GE.threat.health$. The categorical variable $avoid.GE$ captures to what extent (sometimes or never) an individual avoids GE's by purchasing organic and Non-GMO foods. Results are interpreted relative to subjects that report avoiding GE ingredients by buying organic and Non-GMO food. A subjects self-reported view of GE foods is also included in the models as a likert scale from 1 to 5 where 1 = very unfavorable and 5 = very favorable; the $GE.view$ variables are interpreted relative to participants that reported having a very unfavorable view of GE foods. $GE.understanding$ is a categorical variable measuring an individual's self-reported understanding of GE foods and technology ranging from 1 to 4 where 1 = poor and 4 = excellent; in the table, this variable is interpreted relative to individuals that reported having a poor understanding of GE technology. Preliminary analysis shows that whether a subject believes GE technology may pose a threat to their health is a more significant determinant of their food preferences than how much they believe GE technology poses environmental, moral, or religious risks. I therefore also include $GE.threat.health$ as a likert scale from 1 to 5 where 1 = strongly disagree, 5 = strongly agrees, and strongly disagrees is omitted.

All price difference estimates, interaction terms, and attribute coefficients are of the same sign and significance as reported in the previous two tables. The age and age^2 estimates are again negative and positive, respectfully, and significant at the $p<0.0$ level. There are also no significant ethnicity or education effects. Income is once again negative and statistically significant at the 95% confidence level.

Overall, every GE attitudinal variable included in the mixed models is significant at the 90% or greater confidence level. Relative to subjects that actively avoid GE ingredients by purchasing organic and Non-GMO foods, those that only sometimes or do not intentionally avoid GE ingredients are significantly more likely to prefer the conventional Frito-Lay products at the 99% confidence level. All specifications also report positive and significant estimates for those with a somewhat unfavorable, neutral, somewhat or very favorable view of GE foods. This suggests that subjects with very unfavorable views are the most likely to choose the organic and Non-GMO *Simply* products, and even subjects with somewhat unfavorable views are still more likely to choose the conventional Frito-Lay product; this effect is significant at the 90% level and higher. Subjects with a neutral, somewhat favorable, or very favorable view of GE foods are much more likely to opt for the less expensive conventional snack products relative to those with a very unfavorable view of GE foods; across all specification these findings are significant at the 99% confidence level with one exception - for those with a somewhat favorable view of GE foods, the two logit models show significance at the $p<0.05$ level. Overall these results demonstrate that there are significant differences between those with a very unfavorable view and the rest of the sample population. Those with a very unfavorable view are likely to be RCOF's and hold very strong food attribute preferences. In tables 5.2.1 and 5.2.2 I analyze this result further by comparing these results with the estimates produced when I omit RCOF's from the regressions.

When examining how a subject's self-reported understanding of GE foods and technology influence their propensity to prefer the conventional or *Simply* brand, those that report having a good or excellent understanding of GE are significantly more likely than those with a poor understanding to opt for the *Simply* version ($p<0.01$). This is surprising – it suggests that those that believe they are well informed of the risks and benefits of GE foods are more inclined to actively avoid GE ingredients by purchasing organic or Non-GMO products. Subjects with a reported fair understanding of GE ingredients are also less likely to prefer the conventional Frito-Lay product, but this influence is significant at the 90% level in the logits models and at 99% in the mixed logits specifications. Extrapolating from these results, this finding alludes to the possibility that consumers that consider themselves educated about GE technology may be more likely to prefer Non-GE snack products depending on the price at which the goods are offered. This is unusual considering there's a consensus among the scientific community that GE foods do not pose a threat to human health. This alludes to the possibility that consumers may see value in organic or Non-GE products that are not offered in conventional products. Whether the health-halo effect or environmental concerns are driving preferences is debatable, although these results also make it clear that educating consumers about GE technology is not an easy task. In the discussion section I examine this group further, hoping to disentangle further why this subsample opts for organic or Non-GMO labeled products. Lastly, the results of all four specifications reported in table 5.1.3 imply that the more a subject believes GE food or technology may pose a threat to their health, the more likely they are to avoid the conventional Frito-Lay product. This intuitively suggests that those that believe there may be unknown health consequences associated with GE technology are more likely to avoid GE foods, which is reasonably founded.

5.2 Analysis Segmenting by Choice Variability: OCOF's

In sections 5.2.1, I conduct the same analysis as in 5.1.4 but omit subjects that always preferred either the *Simply* (RCOF's) or conventional Frito-Lay variety throughout the entire choice survey. RCOF's are omitted because regardless of price or additional information, these consumers exhibit staunch preferences for the organic and Non-GMO attributes and therefore do not contribute valuable information to our analysis regarding how treatments influence preferences. I also assume subjects that always stated their preference for the conventional Frito-Lay product receive zero utility from the attributes of the *Simply* product, namely the organic and Non-GMO certifications, and thus their responses do not provide the identifying variation necessary to understand the treatment effects. Our analysis in this section is focused on the occasional consumer of organic food (OCOF). While 13% of these OCOF's reported never purchasing organic or Non-GMO products, these participants did indicate a preference for the *Simply* variety in a number of choice scenarios and therefore, for simplicity, I will still consider these subjects OCOF's.

Out of 388 total subjects, 61 always preferred the *Simply* brand (RCOF's), and 65 opted for the conventional Frito-Lay product. The new sample size is 262. After segmentation, 21% of the remaining sample population falls in the control group, 23% in Treatment 1, 18% in Treatment 2, and 19% in Treatment 3 and 4. This near equal distribution among treatment groups allows us to confidently identify the price difference and treatment effects. We hypothesize that when the *Simply* and conventional Frito-Lay products are the same price, OCOF'S will opt for the *Simply* option regardless of information treatment (*H2.a*). Conversely, when the *Simply* product is priced higher than the conventional version, we expect subjects will be more price sensitive and more likely to prefer the conventional Frito-Lay brand (*H3.a*). However, we hypothesize that participants in the positive information treatment groups will be more price sensitive and less likely to prefer the *Simply* brand (*H4.a*).

5.2.1 OCOF's: Base Model with Self-Reported GE Attitudinal Factors: Table 5.2.1

The results reported in Table 5.2.1 are derived from the same specification outlined in Section 5.1.4:

$$\ln\left[\frac{P_{ict}}{1-\ P_{ict}}\right] = \ \beta_0 + \ \ \beta\ ATTRIBUTES_c' - \alpha\ PRICEDIFF_{iCt}$$
$$+\ \delta_j\ TREATMENT_i + \ \gamma_j D_i' \ + \ \omega_j GE_i{}'$$

All price difference estimates are positive and statistically significant at the 99% confidence level, and the coefficients are greater than the price different parameter estimates reported in Table 5.1.3; this is intuitive, since those that occasionally consume organic products are more likely to be more price sensitive than those that regularly or never purchase organic and Non-GMO certified foods. However, this result may be confined to packaged snack products. OCOF's may be more price sensitive in one food category, but less price sensitive in another; for example, some OCOF's may always purchase organic fruits, vegetables, or dairy products, but may not have as set preferences for meat or grain products. There are no observed treatment effects so overall, we reject *H6*.

Among the interaction terms, only the 30¢ price difference interacted with treatment 1 is negative and significant at the 95% level in the mixed logit model, suggesting that when the Simply version was only 30¢ more expensive, subjects in the first treatment group displayed a greater propensity to prefer the *Simply* version relative to the control group. In terms of product attributes, the coefficient estimate on the potato variable is negative and statistically significant at the 99% confidence level across all models, suggesting OCOF's are more likely to choose the *Simply* potato product relative to the *Simply* corn-chips. OCOF's also display slightly significant ($p<0.10$) different preferences for the organic and Non-GMO attributes among the potato chips; OCOF's are more likely to choose the *Simply* potato chips that are Non-GMO certified relative to the *Simply* potato chips that are organic, potentially suggesting these two labels are not weighted equally.

The predictive ability of socio-demographic variables on OCOF's preferences for food product attributes is weak. Age and Age^2 are negative and positive, respectively, and statistically significant at the 95% across the mixed logits; this result mirrors past analyses. Other relationship status is negative and statistically significant ($p<0.05$) across all specifications, but only 2 participants fall into this category. Ethnicity is not significant, and it's worth noting that 82% of OCOF's in our survey are white. Income effects are present and as strongly significant as in past models. Overall the results suggest an OCOF's level of income may significantly influence their preferences for conventional and organic/Non-GMO food.

Attitudinal factors also do not appear to be as significant of a determinant in preferences for food product attributes as in past analyses. Relative to those with a poor view of GE foods, respondents with a very favorable view are significantly more likely to opt for the conventional brand ($p<0.01$). Lastly, those with a reported good and excellent understanding of GE technology and food are significantly less likely ($p<0.01$), across all models, to prefer the conventional Frito-Lay products. This result echoes past findings.

5.3 Analysis Segmenting by Self-Reported View of GE Foods and Technology

In this section, I segment participants by their self-reported view of GE foods and analyze the choices of each subdivision separately. Before analyzing the results of the logit and mixed logit models, I plot the total percent of conventional choices for those with a favorable, neutral, and unfavorable view of GE foods on separate graphs to visually examine how food preferences among these three groups differ. In Figure 5.3.1, I plot the total percent of times the conventional Frito-Lay chip was chosen only among those that identified as having a somewhat or favorable view of GE foods (n=105). Figure 5.3.2 displays the percent of conventional choices among those with a neutral view (n=170), and Figure 5.3.3 plots the percent of conventional choices made among those with a somewhat or very unfavorable view (n=113). It is most evident that those with an unfavorable view display the lowest incidence of choosing the conventional products across all treatments and price differences. Among the unfavorable group, participants in the 4th no-information treatment displayed the greatest percentage of choosing the conventional option. Unexpectedly, subjects that reported having neutral views chose the conventional Frito-Lay product more than those with favorable views, which leads me to believe that other unobservable product attributes, such as quality, taste, or nutrition, may be influencing preferences. These self-reported views may also be subject to measurement errors.

Table 5.3.1 reports the results when the analysis is conducted only on participants that classify themselves as having a favorable view of GE foods, Table 5.3.2 includes only those with a neutral view, and Table 5.3.3 is segmented so that only subjects with an unfavorable view of GE foods (n=113) are in the analysis. In terms of percentages, 29% of all participants either view GE foods as very or somewhat unfavorable, 44% of subjects report holding neutral views, and 27% view GE foods as very or somewhat favorable. All models once again incorporate product attribute, socio-demographic, and additional GE attitudinal variables. The only difference between this model and model 5.1.3 is ethnicity, income, and education are included as binary variables.

Ethnicity is interpreted relative to those that identified as white, income is interpreted relative to those with yearly household earnings less than \$25,000, and education is interpreted relative to those that at most earned a High School degree. The specification is below:

$$\ln\left[\frac{P_{ict}}{1-\ P_{ict}}\right] = \ \beta_0 + \ \ \beta\ ATTRIBUTES_c' - \alpha\ PRICEDIFF_{iCt}$$

$$+\ \delta_j\ TREATMENT_i + \gamma_j D_i'\ +\ \omega_j GE_i{}'$$

5.3.1 Favorable GE View: Table 5.3.1

As in all previously reported tables, the results of all logit and mixed logit models return positive and highly significant (p<0.01) estimates for the three price difference variables. Treatment 1 is positive and statistically significant at the 90% level across all models, and significant at the 95% level in the logit model when interaction terms are omitted. This result suggests that among OCOF's and those with a favorable view of GE foods, participants that received additional information regarding the established scientific safety of GE foods were even more likely to choose the conventional product relative to those that only received information about the conventional products containing GE ingredients. However, subjects in treatment 3 were also exposed to similar safety information as well as given additional facts regarding GE's ability to reduce food waste, yet this treatment is not significant. In contrast, the interaction term between treatment 3 and the 30¢ price difference variables is actually negative and significant at the 95% level in the logit model, implying when the *Simply* product was only 30¢ more expensive, participants with favorable GE views in the third treatment group were less likely to choose the conventional version relative to those in the control group. However, the mixed logit model does not produce similar results.

The potato dummy variable is negative and statistically significant at the 99% confidence across all four models, mirroring past findings, although the Non-GMO potato interaction term loses its' significance. Age and age^2 continue to be negative and positive, respectively, and statistically significant at the 99% level. Only the two mixed logit models produce negative and significant estimates for the other relationship status variable; however, as previously noted, this group constitutes a minor portion of the population. The influence of ethnicity reported by this table contradicts earlier null findings; the African American variable is no longer significant, and Hispanic is negative and significant at the $p<0.05$ level only in the mixed logit models. For the first time, Asian is also negative and significant at the 90% level across both mixed logits and logit 8a. There is not enough evidence to suggest that relative to white people, Hispanics and Asians with a favorable view of GE foods are less likely to prefer the conventional snack products. Strong income effects are once again present when only considering those with a favorable view of GE food; subjects that make more than $25,000 a year and are not opposed to GE technology are still more likely to prefer the GE-free *Simply* brand relative to those that make less than $25,000. However, education levels does not significantly affect preferences of those with favorable views.

Segmenting participants by GE view notably diminishes the explanatory powers of GE attitudinal variables. Only the two logit models produce positive and significant ($p<0.05$) estimates for the variable that indicates if a subject does not avoid GE ingredients, broadly implying that subjects that do not intentionally avoid GE ingredients are more likely to prefer the conventional product than subjects that sometimes avoid GE foods, even among those with favorable GE views. The only other significant attitudinal variable is fair understanding of GE, which is negative and significant at 95% in mixed logit 5 and at 90% in mixed logit 5a. Interpreted, this result implies that participants with favorable GE views that also report having a fair understanding of GE foods are less likely to prefer the conventional Frito-Lay products relative to subjects that reported having a poor understanding of GE foods; this effect could be driven by many unobservable factors.

5.3.2 Neutral GE View: Table 5.3.2

We next only consider participants with a self-reported neutral view of GE foods. The price difference impacts remain statistically significant at the 99% confidence level, implying even those with a neutral view are more likely to choose the conventional product whenever it is priced lower than the *Simply* variety. When the logit and mixed logit specifications exclude the price difference treatment interaction terms, Treatment 1 is negative and statistically significant at $p<0.10$. This result differs drastically with the findings reported in Table 5.3.1; while those with a favorable view were more likely to opt for the conventional product after reading the scientific information paragraph, those with a neutral view were less likely to prefer the conventional product. Treatment 3 in logit 6 is also negative and significant at the 90% level, suggesting that providing food-waste reduction benefits in addition to stating the scientific safety does not make subjects any more likely to prefer the conventional Frito-Lay products.

Somewhat interestingly, the only statistically significant interaction effects produced by the logit model are between Treatment 2 and the three price difference variables; all coefficients are negative, but not highly significant. Treatment 2 did not provide any information about the safety of these crops, which may have made consumers more prone to prefer the non-GE *Simply* variety. These findings may therefore be attributable to some signaling effect, since those with a neutral view of GE foods may be prone to mistrust unfamiliar information sources. Even though the treatments did cite accredited sources, simply being given this information within a survey may have skewed some people's preferences. The product attribute estimates are the same as reported in tables 5.1.1-5.1.3; the potato variable is negative and statistically significant ($p<0.01$) across all four models, while the Non-GMO potato indicator estimate is also negative and significant at the 95% confidence level.

While there are slight significant differences in the socio-demographic makeup between those in the neutral group and other participants, these dissimilarities do not result dispel the significance of the findings reported below. The parameter estimates on age and age^2 are negative, and positive, respectively and continue to be statistically significant ($p<0.05$ or $p<0.01$) determinants of an individual's propensity to prefer the conventional relative to the *Simply* products. However, no ethnicity variables are significant, suggesting that ethnicity might not influence preferences of subjects with a neutral view of GE food. Please note among those holding a neutral view of GE foods, no subjects are classified as having an ethnicity other than white, African American, Hispanic, or Asian, so the variable "other ethnicity" is omitted from the model.

Education variables are no longer significant as well. However, very interestingly, the income effects reported in this table appear to be isolated to subjects that reported housing earnings over $100,000. Past specifications have led to results that suggest all participants with household incomes over $25,000 were significantly more likely to prefer the *Simply* brand relative to those making less than $25,000 annually. However, when we insulate subjects with a neutral view of GE, only the estimate on income > $100,000 is negative and statistically significant at the 99% level in the mixed logits and 95% in the logits. This result is more digestible, as it's unlikely that those making between $25,000-$50,000 are not even a little price sensitive. This result strengthens our previous findings regarding incomes impact on food attribute preference, but also insinuates that unobservable forces are also at play.

Considering the attitudinal variables, in Table 5.3.2, we see that subjects with a neutral view of GE foods that actively avoid GE ingredients are significantly less likely to prefer the conventional Frito-Lay product than those that sometimes avoid GE's ($p<0.01$). Similarly and as reported in past tables, those that believe GE threats may pose a threat to human health are also less inclined to prefer the conventional version; this result is statistically significant at the 95% confidence level. Interestingly, within the group that has an overall neutral view of GE but also actively avoid GE foods, 51% somewhat or strongly disagree that GE foods may pose a threat to human health. The parameter coefficients for those that self-reported having a good understanding of GE foods is negative and significant at the 90% level in the logit models, but at the 99% level in both mixed logit models. This broadly implies that within the neutral group, subjects with a good understanding of GE foods and technology are more likely to opt for the *Simply* version, echoing earlier findings. It is also worth noting that among those with an overall neutral view of GE that also report having a good understanding of GE foods, 48% take a neutral stance regarding GE's impact on human health, while 31% somewhat agree and only 2% strongly agree. The parameter estimate on those with an excellent understanding of GE food is significant at the 90% level only in the mixed logit models.

5.3.3 Unfavorable GE View: Table 5.3.3

I now focus my analysis only on subjects that reported having a somewhat or very unfavorable view of GE foods and technology (n=113). In total, 56 participants reported having a very unfavorable view of GE foods, while 57 subjects have a somewhat unfavorable view. As expected, the parameter estimates on all price difference variables are positive and statistically significant at the 99% significance level across all specifications. However, the coefficient on

Treatment 2 is negative and statistically significant at the 95% level in the logit models, and 90% in the mixed logit models. Interpreted, this suggests that subjects with unfavorable views that received information on the food-waste reduction benefits of GE foods were less likely to choose the conventional option produced with GE ingredients relative to the control group, who were only informed that the less expensive conventional products contain GE ingredients. Because Treatment 3 does not produce any significant results, even when interacted with price difference, it is likely this outcome could be a function of a signaling effect coupled with a lack of scientific information reaffirming the safety of GE foods.

However, when Treatment 1 is interacted with price difference, there are negative significant results across all price differences. The interaction term between the 30¢ price difference and Treatment 1 is significant at the 95% level in the logit model and 99% in the mixed logit. This result suggests those with unfavorable views in the scientific treatment group were less likely than the control group to choose the conventional Frito-Lay product when the *Simply* version was only 30¢ more expensive. When the 50¢ price difference variable is interacted with Treatment 1, both models exhibit negative estimates at the 90% significance level, and only the mixed logit produces a 90% significant treatment effect when interacted with the 80¢ price difference. However, only 15 of the 113 participants in this subgroup were in the scientific treatment, so these results may be overstated due to insufficient sample size. These results may also be revealing some signaling effect, although broadly these findings suggest that espousing positive, scientific information may not be an effective tactic to sway the opinion of those with unfavorable views of GE foods.

Nearly all explanatory power from socio-demographic variables is dissipated when the model specification only includes subjects with unfavorable views of GE foods. Age and age^2 are at most significant at the 95% level in the mixed logit models; signs are the same as in previous tables. Other ethnicity is significant at the 90% level in the logit models and the 99% level in the mixed logit models, although only 4 of the 113 participants in this group are classified as other ethnicity, so this result is irrelevant. There are zero income effects, and a slight education effect; the mixed logit models produce a negative and significant ($p<0.10$) coefficient on the some college variable. Broadly speaking, these results suggest that an individual's view of GE foods is a more important indicator of their food attribute preferences than their socio-demographic variables, although socio-demographic variables may very well inform their view of GE foods. However, the influence of socio-demographic characteristics on food attribute preferences does not appear to be systematic.

Next we consider how attitudinal variables affect an individual's propensity to prefer the conventional Frito-Lay product relative to the *Simply* versions. As expected, an individuals' self-reported understanding of GE, and whether they actively avoid GE ingredients or believe GE foods might pose a health threat, are among some of the most significant factors influencing preferences. The mixed logit models produce negative and statistically significant estimates for the "avoids GE" variable at the 99% and 95% confidence levels. How strongly an individual believes GE foods may pose a threat to human health is negative and statistically significant at the 99% level across all models. Lastly, those that report having a good or excellent understanding of GE foods and technology are substantially less likely than those with a poor understanding to prefer the conventional Frito-Lay product. This effect is significant at the 99% level across all models for those with a reported good understanding, as well as the mixed logit estimates for those with an excellent understanding. The mixed logit models estimate on fair understanding is statistically significant at the 95% level. These individuals likely identify as OCOF's or RCOF's, sometimes or frequently avoiding GE foods by purchasing organic and Non-GMO. This group also seems to be more aware of how prevalent GE foods are; on average, those with very unfavorable views believed 67% of products in a grocery store contain GE ingredients, an estimate very close to the actual appraisal of 70%, while those with somewhat unfavorable views believe this number is lower around 55%.

5.4 Factor Analysis: Risk and GE Threats

Lastly, I investigate the role of risk in determining consumer preferences for GE and Non-GE snack products. As thoroughly discussed in the literature review, the perceived risk and benefits associated with GE foods can influence an individual's perception of food products produced with GE ingredients. We expect that subjects with higher levels of risk aversion will be more likely to prefer the non-GE *Simply* variety than those with lower levels of risk aversion. To test this hypothesis, I first include variables that signify on a scale from 1-10 how risky an individual considers their behavior in terms of business ventures, career, and education, 10 being very risk. I also include five variables that indicate how strongly a participant agreed with the following statements: (i) I believe GE foods may be a threat to my health, (ii) I believe GE foods may be a threat to the environment, (iii) I avoid GE foods for moral reasons, (iv) I avoid GE foods for religious reasons, and (v) I am skeptical of the technology used to produce GE foods. These variables are included to gauge how risky subjects perceive GE technology.

Table 5.4.1 reports the results of the logit specification when these risk and GE threat variables are added independently to the base model. No risk or GE threat variables produce significant estimates. I examine the correlation between the five GE threat variables and find that the health, environment, and skeptical GE threat variables are highly correlated; the correlation matrix is reported in Figure 5.4.1 in the Appendix (R^2=0.84 between health and environment, R^2=0.71 between health and skeptical, and R^2=0.66 between environment and skeptical). I therefore create two separate factor variables, the first including all GE threat terms ($GE\_threats$), and the second only including the health, environmental, and skeptical GE threat terms ($GE\_threats\_1$). I then run two separate logistic regressions with all risk variables independently, as well as include one GE threat factor variable per regression. These results are reported in Table 5.4.2. We do not find significant results when all GE threat variables are included as $GE\_threats$; however, we do find that $GE\_threats\_1$ is negative and statistically significant at the $p<0.10$ level, suggesting the more a subject agrees that GE technology may pose a health or environmental risk and the more skeptical they are, the less likely they are to prefer the conventional Frito-Lay product.

Next I construct a correlation matrix between the three risk variables, and once again find they are strongly correlated, but not to the extent that the GE threat variables were correlated (R^2=0.63 between business and career, R^2=0.68 between career and education, and R^2=0.40 between business and education). I then create a factor variable from these three risk variables, and run a logit specification including the risk and GE threat factor terms, the results of which are reported in Table 5.4.3. Once again, the risk term is not significant, and $GE\_threats\_1$ is negative and statistically significant at the 90% level. Overall we do not find strong evidence that an individual's level of risk aversion significantly influences their preferences for foods produced with GE ingredients.

VI. Discussion and Conclusion

6. 1 Discussion and Implications

The first most meaningful and consistent finding is that price plays a highly statistically significant role in subject's choices; relative to when the Frito-Lay and *Simply* products were priced equally, subjects largely preferred the conventional Frito-Lay snack whenever it was less expensive than the *Simply* version. While 126 of the 388 total respondents always preferred either the conventional or *Simply* version, 262 subjects did vary their choices between the two brands based on their preexisting preferences, attitudes towards GE foods, and given prices.

The second most consistent and expected finding is that in all the mixed logit specifications reported, the random parameters imposed on the price difference variables were statistically significant at the 99% level. Such strong evidence suggests strong heterogeneity in subject's sensitivity to price at each price point. This strong preference for the *Simply* product when the two produces are priced equally may also imply that regardless of the safety or benefits of GE crops, consumers do value either the observable characteristics of the *Simply* products, namely the organic and Non-GMO labels, or unobservable characteristics, such as quality or taste.

Overall we find little evidence that the positive information treatments significantly increase a participant's propensity to opt for the conventional Frito-Lay products made with GE ingredients over the *Simply* brand. Most significant results were weakly statistically significant, inconsistent, and often the opposite of what we hypothesized. Relative to just being informed that the cheaper conventional product was produced with GE ingredients, it seems intuitive that subjects who were also informed of GE's food-waste benefits would have been more likely to prefer the conventional option, given the additional value. However, we find little evidence for this hypothesis. On the contrary, some specifications found that subjects informed of the food-waste benefits were less likely to prefer the conventional products.

In comparison, a few specifications suggested the scientific treatment appeared to positively and significantly increase preferences for the conventional products. While intuitively we expect the scientific treatment group to be more likely than the control to prefer the conventional Frito-Lay products since the control group had no information regarding the safety or benefits of GE crops, it is somewhat interesting that this treatment had a positive effect while treatment 2 showed signs of a negative effect. This potentially gives rise to the idea that subjects' preferences are driven more by health than environmental concerns. Given this logic, Treatment 3, which touted both the safety and food-waste benefits, should have displayed the strongest positive effects, although we did not uncover such findings.

As noted in the literature review, the risk assigned to GE foods is a function of the perceived benefits and perceived necessity of the technology. In our sample, 62% percent agreed that food waste is a pressing environmental issue, while 31% said they didn't know or were indifferent. Only 28% of participants indicated they were more likely to accept and consume GE foods if the crops were developed to help reduce food waste, while 30% were somewhat more likely, and 35% indifferent. Given these findings, it is possible that the subjects did not perceive food waste to be a sufficient reason to shift their demand for GE food at various price points. ---This conjecture is supported by research; even when experts provide information regarding the benefits or other trusted sources, negative information and press tend to dominate (Frewer et al. 1997). Applied to this study, this "negativity bias" as termed by Kahneman, Knetsch, and Thaler (1991) suggests that consumers may recall the potential consequences of GE technology more readily than the benefits. The food-waste reduction benefits touted in this study may not have been tangible enough to participants. However, it is unwise to assume that subjects would have preferred the snack product produced with GE ingredients even if they were aware of biotechnology's potential to deliver substantial societal and environmental benefits.

With the exception of age and income, socio-demographic factors resoundingly did not appear to significantly affect preferences. This is consistent with the most recent research studies on this topic, which find that socio-demographic factors are less of a predictor of food preferences than previous literature suggests. While the likelihood of opting for the non-GE *Simply* version first increases with age, after a certain age this propensity reverses. This in part could be a function of other unobservable factors, such as familiarity with the *Simply* brand or the number and age of children in the household. While some ethnicity variables were significant in a few of the specifications, our sample size primarily consisted of those that identified themselves as white (n=318, or 82%). Therefore, I do not draw any definitive conclusions regarding race's predictive ability in this context.

The level of education a subject has received also does not appear to systematically influence their preference for the conventional or *Simply* product. A few specifications reported significant positive estimates for subjects that have achieved some college, a population that represents 25% of the total sample size (n=97). It is unclear why those that completed some college were so much more inclined to choose the less-expensive conventional product than those with a high school degree or less. Given the observed income effects, I would have expected those with a college degree or higher to display a greater propensity to prefer the more expensive *Simply* version. While most specifications indicated all participants earning more than $25,000 were more likely to prefer the *Simply* products than households earning less than $25,000, this effect seems exaggerated. I expected the organic health-halo effect to increase the incidence of *Simply* choices among wealthier participants, but I did not expect income effects to trickle down to the $25,000-50,000 income bracket.

We cannot conclusively state that a consumer's preference for organic or non-GMO food products is solely a result of their desire to avoid genetically engineered ingredients, but may also be a function of their desire to realize the perceived benefits of organic food production. More and more consumers have been demanding organic and natural products, whether because they believe organic foods are tastier, healthier, of higher quality, or represent a more sustainable agricultural production system. The validity of these reasons is irrelevant; what is important to consider when evaluating preferences is the utility consumers receive from conventional, organic and Non-GMO products. The results of this study suggest that marketing the food waste reduction benefits of GE crops may not be the most efficient promotion tactic, and additional benefits may be needed before consumers truly value and prefer these GE varieties.

6.2 Future Research: The Presentation of Information

This study calls into question how the presentation of information influences preferences. At the point of purchase, consumers consider many dynamic pieces of information. When choosing between different food products, for example, some factors a consumer might consider are price, flavor profile, nutritional value, product attributes, and production method, among many others. How additional information aids a consumers purchasing decision varies greatly depending on the environment, for example whether that consumer is in a brick and mortar grocery store, purchasing food online, or at a café. Additional information about a product can be on a shelf talker in a grocery store, below a products image on a webpage, or on a menu. If and how that information aids a consumer's preference also depends on their level of interest; some individuals may be more likely than others to digest that information and use it to make an informed decision. More apathetic consumers may not process additional information at all. Furthermore, the amount of time between being presented information and making a relevant purchasing decision also affects preferences. It is reasonable to hypothesize that more recent experiences are more salient and have a greater influence on preferences than information that was processed in the past. In the context of this study, subjects are given a paragraph of plain-text information about GE foods and then are asked to choose between GE and Non-GE products immediately afterwards. Whether the information we presented to the subjects actually changed their previously held preferences is debatable. However, if there is a lag between being given information and having to choose between products, consumers may not as heavily weigh that information during the decision making process because it is not as salient and thus may be harder to recall. This hypothesis is supported by our study; participants in the no information treatment were the most likely to choose the conventional product across all price differences, whereas subjects that were informed that the cheaper conventional product contained GE ingredients were less likely to prefer that option, despite being informed of the benefits of GE foods. This is an area that is understudied, and given that education is often touted as a way to inform consumers that GE foods are as safe as their conventional counterparts, understanding how best to educate consumers is an important research area in food economics.

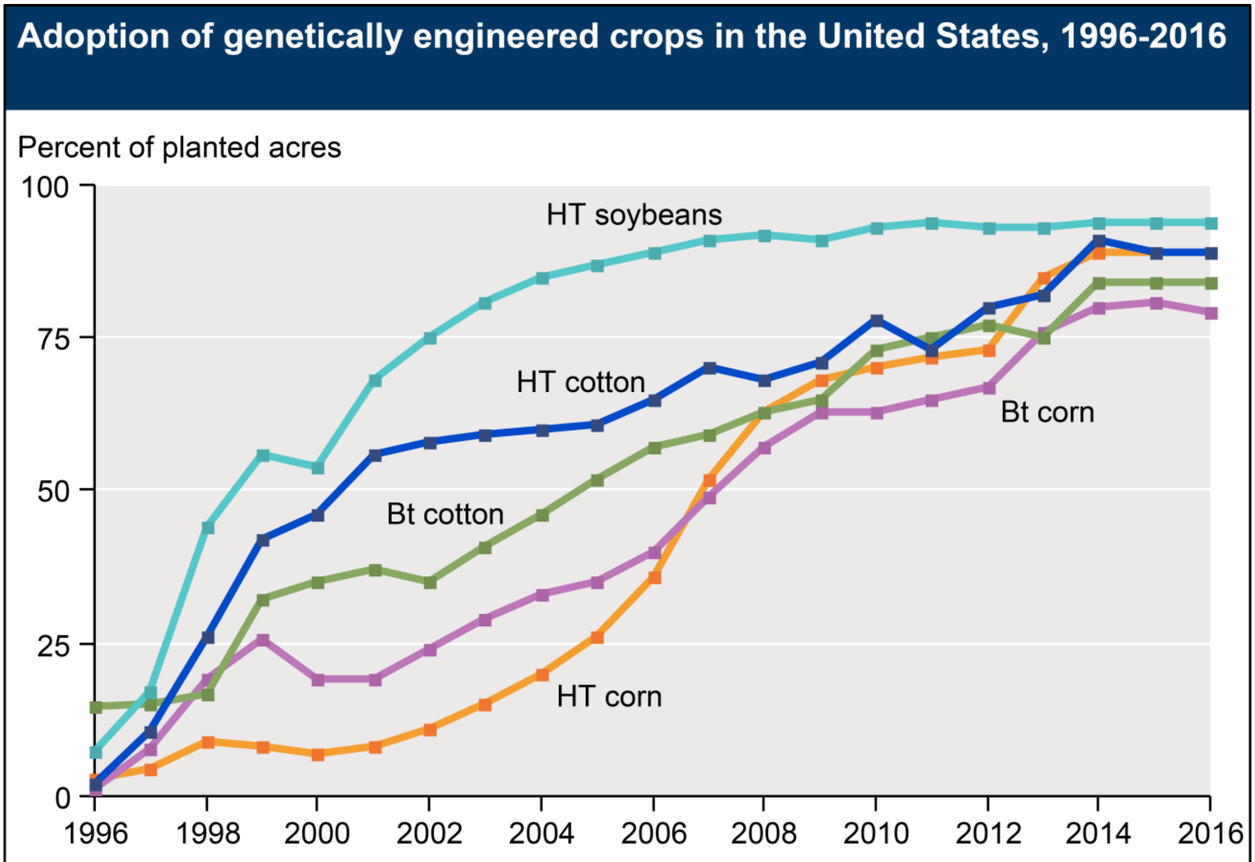
6.3 Concluding Remarks

As food retailers scramble to increase their organic and Non-GMO offerings, the results of this study suggest marketing GE varieties like the Innate Potato and Arctic Apple to consumers may prove difficult. The findings above suggest scientific safety plays a greater role in defining preferences than food-waste reduction benefits, however not providing any information about GE ingredients increases consumer's propensity to choose the less expensive conventional option. While past studies have shown consumers do value tangible benefits of GE crops, such as increased nutritional content, it does not seem that the subjects of this survey valued the food-waste benefits of GE technology enough to switch their preferences. These results weaken the recommendation of using education as a remedy to improve the public's perception of GE crops.

However, that is not to say that consumers do not care about food waste. Seventy-seven percent of our survey subjects agree that consumers should actively try to reduce food waste, and 77% also that technology ought to be utilized to reduce food waste from producers and processors. While people agree the appropriate steps must be taken to reduce food waste, promoting biotechnology as a food waste reduction mechanism may not be the most efficient way to increase consumer acceptance of GE crops. While many efforts are currently being undertaken to reduce food waste, this study calls into question where food waste reduction efforts ought to be directed. Currently biotechnology is just one channel being employed to combat food waste, but given consumers skepticism of GE crops, efforts directed at minimizing food waste where it is greatest, in the consumer's home, may prove to be the most efficient food-waste reduction tactic.

APPENDIX

Figure 1.1.



Data for each crop category include varieties with both HT and Bt (stacked) traits.
Sources: USDA, Economic Research Service using data from Fernandez-Cornejo and McBride (2002) for the years 1996-99 and USDA, National Agricultural Statistics Service, *June Agricultural Survey* for the years 2000-16.

Figure 1.2

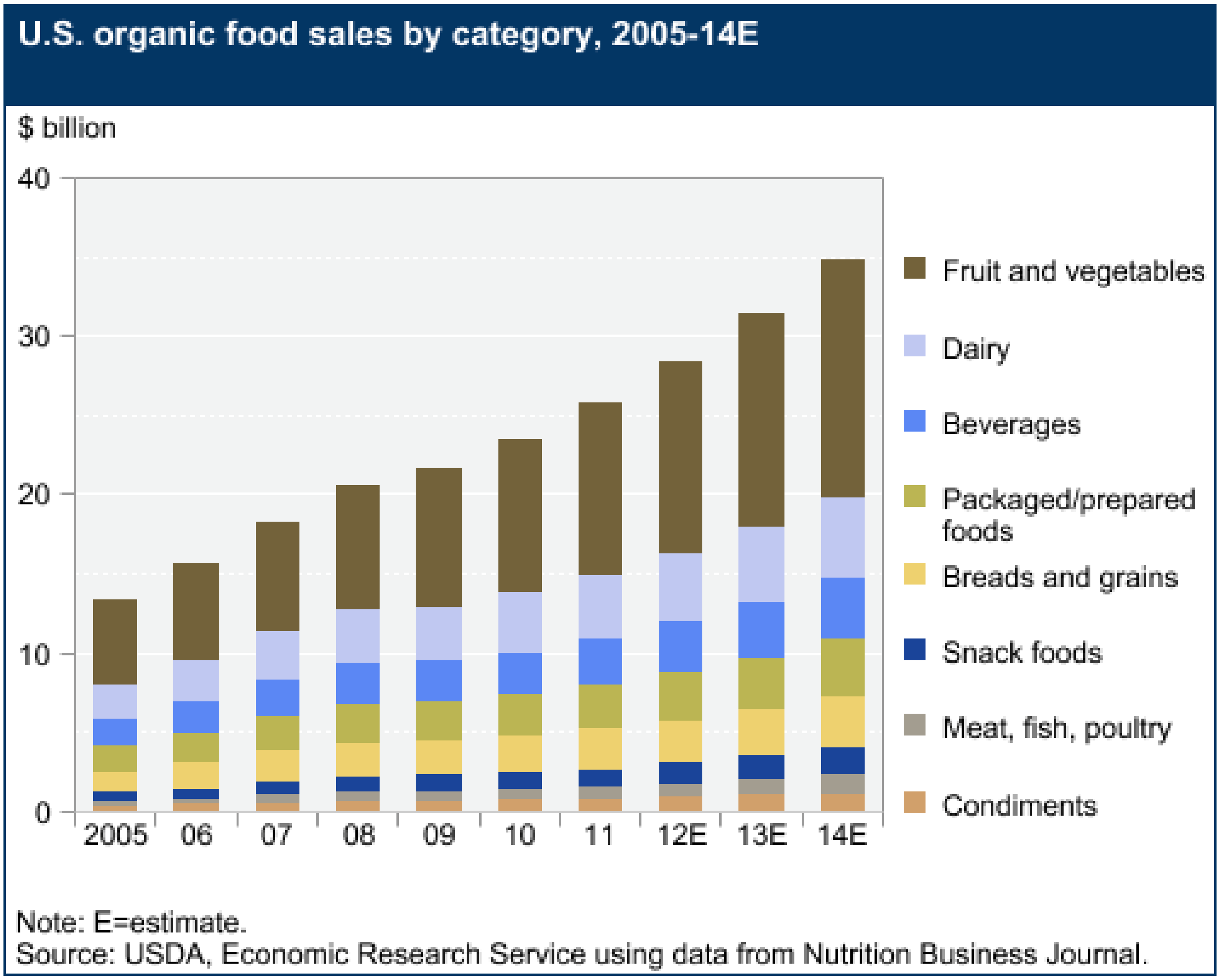

U.S. organic food sales by category, 2005-14E
$ billion
40
30
20
10
0
2005
06
07
08
09
10
11
12E
13E
14E
Fruit and vegetables
Dairy
Beverages
Packaged/prepared foods
Breads and grains
Snack foods
Meat, fish, poultry
Condiments
Note: E=estimate.
Source: USDA, Economic Research Service using data from Nutrition Business Journal.

Figure 4.1.

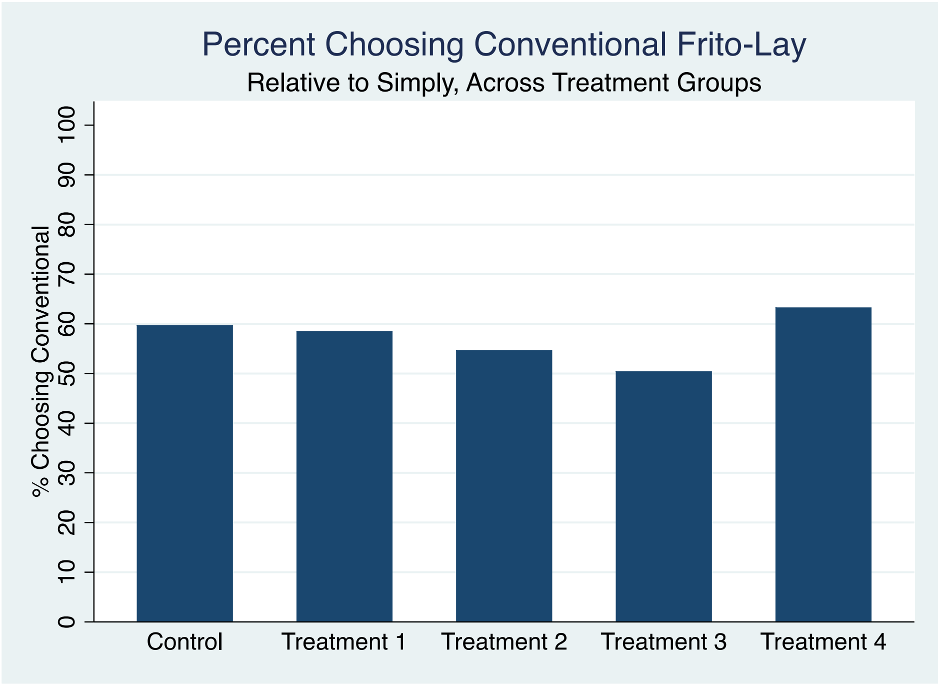


Figure 4.1a.

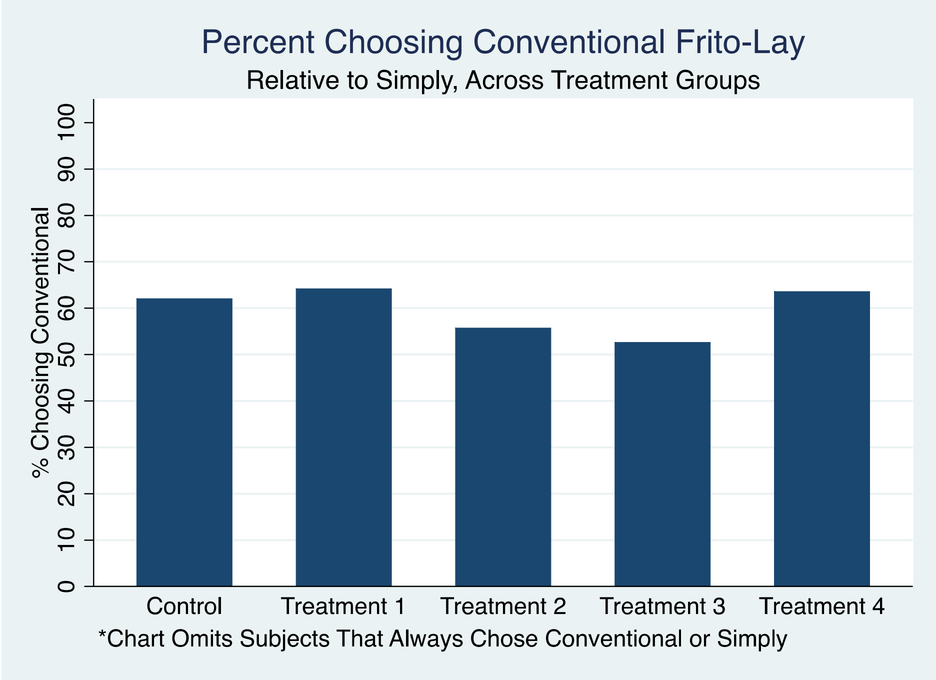


Figure 4.2.

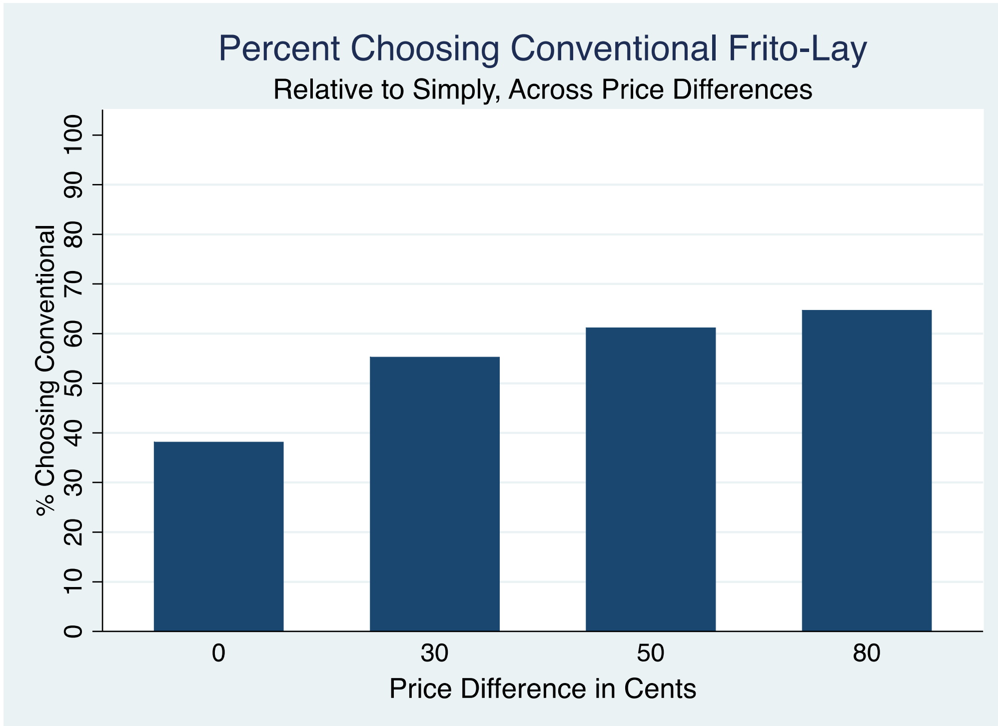


Figure 4.2a.

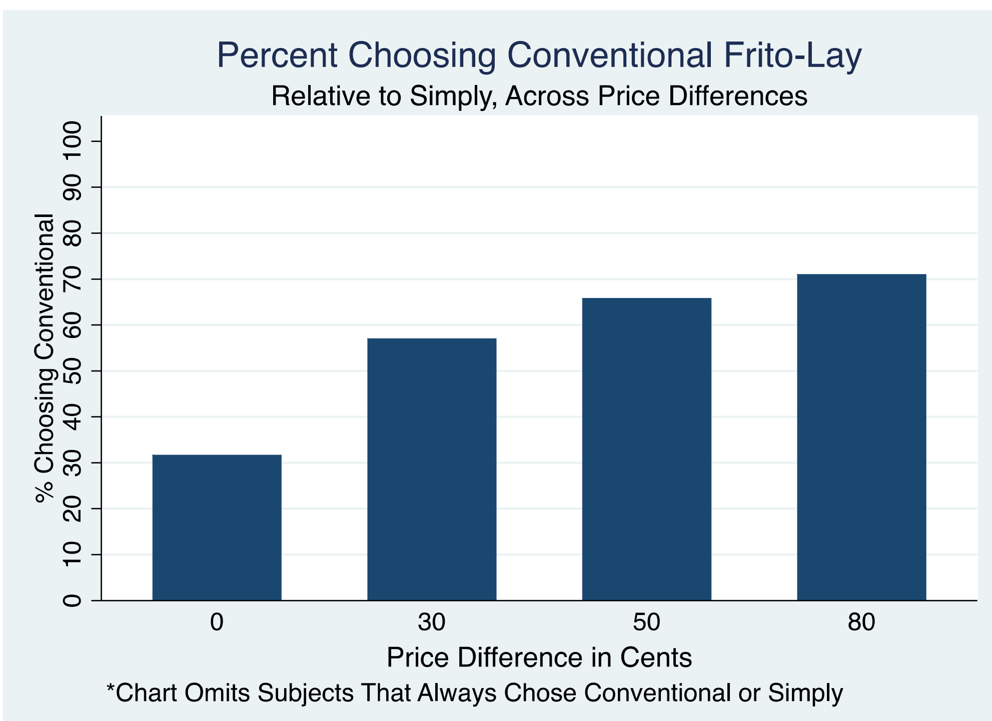


Figure 4.3.

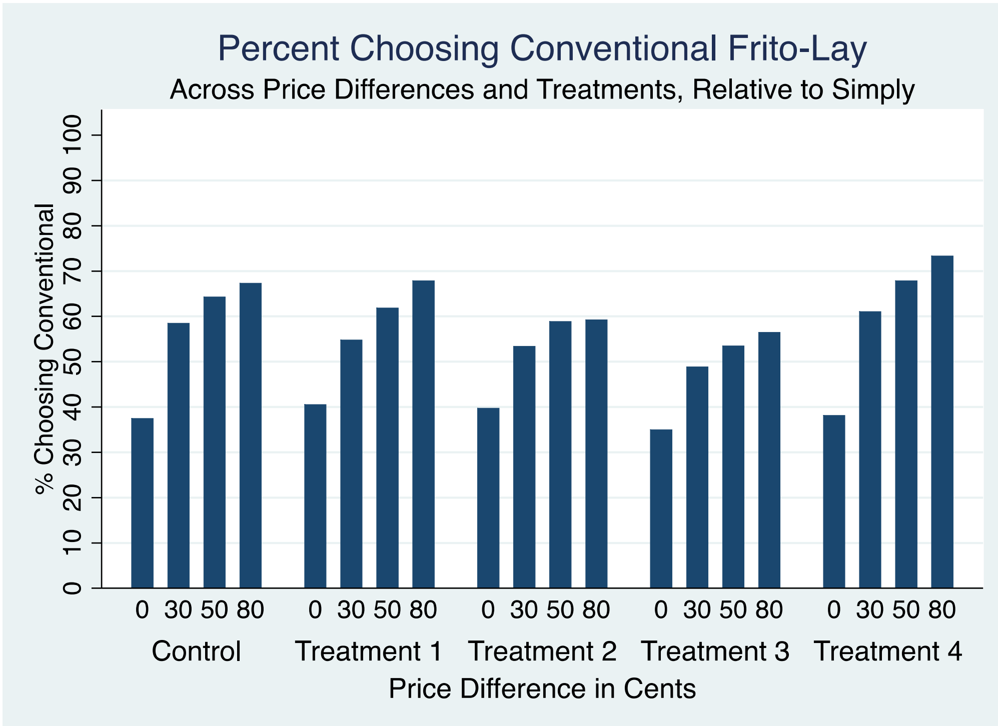


Figure 4.3a.

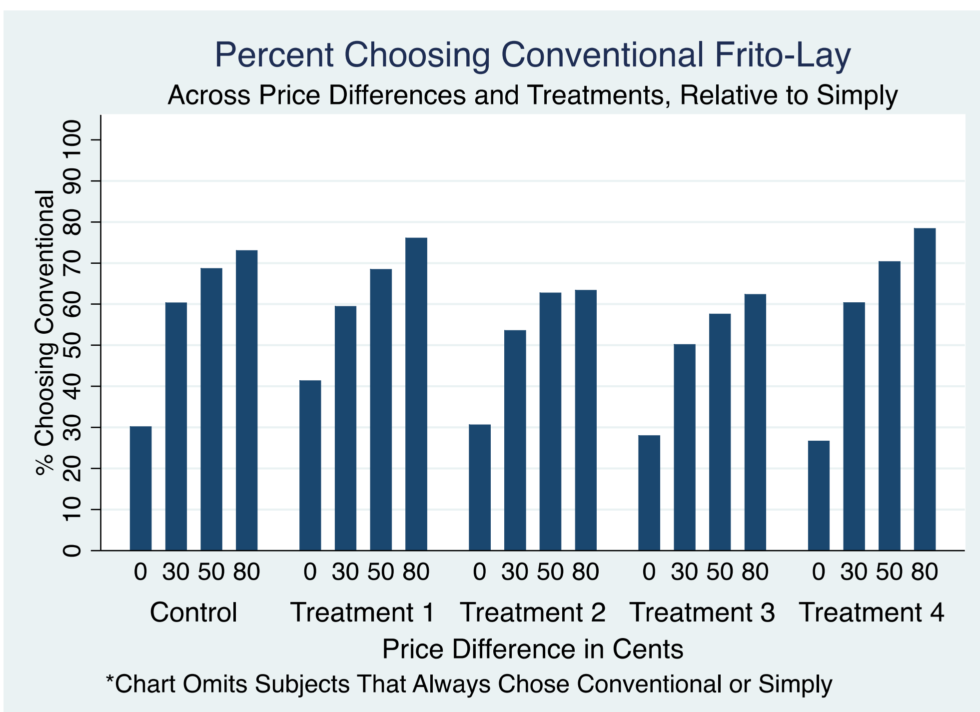


Figure 4.4

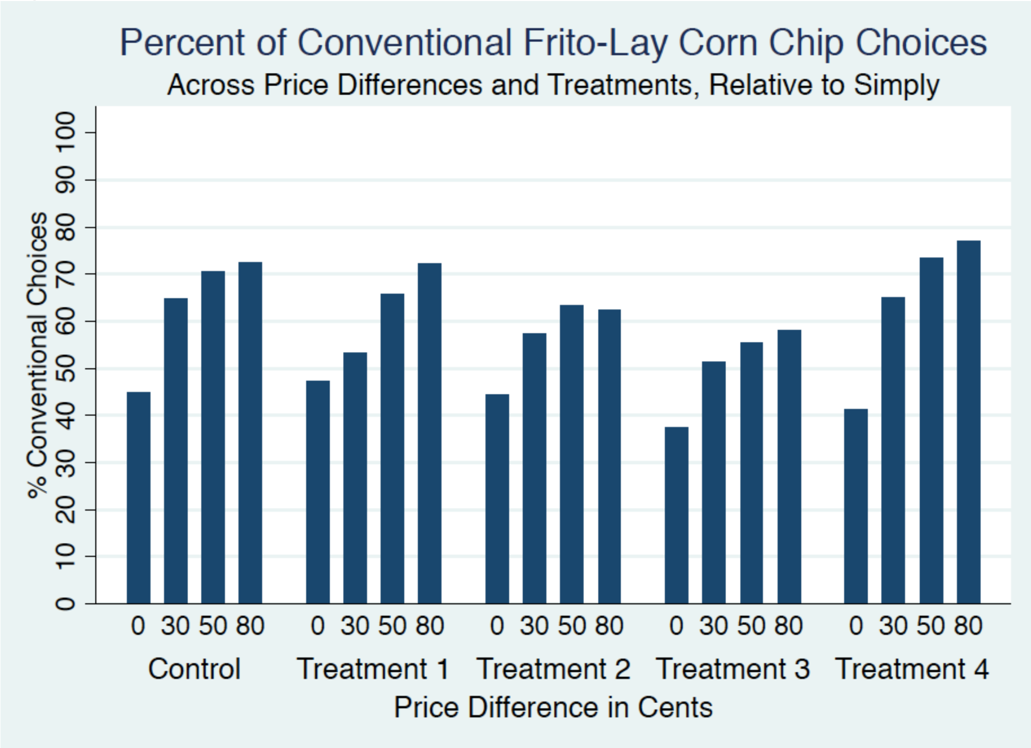


Figure 4.5

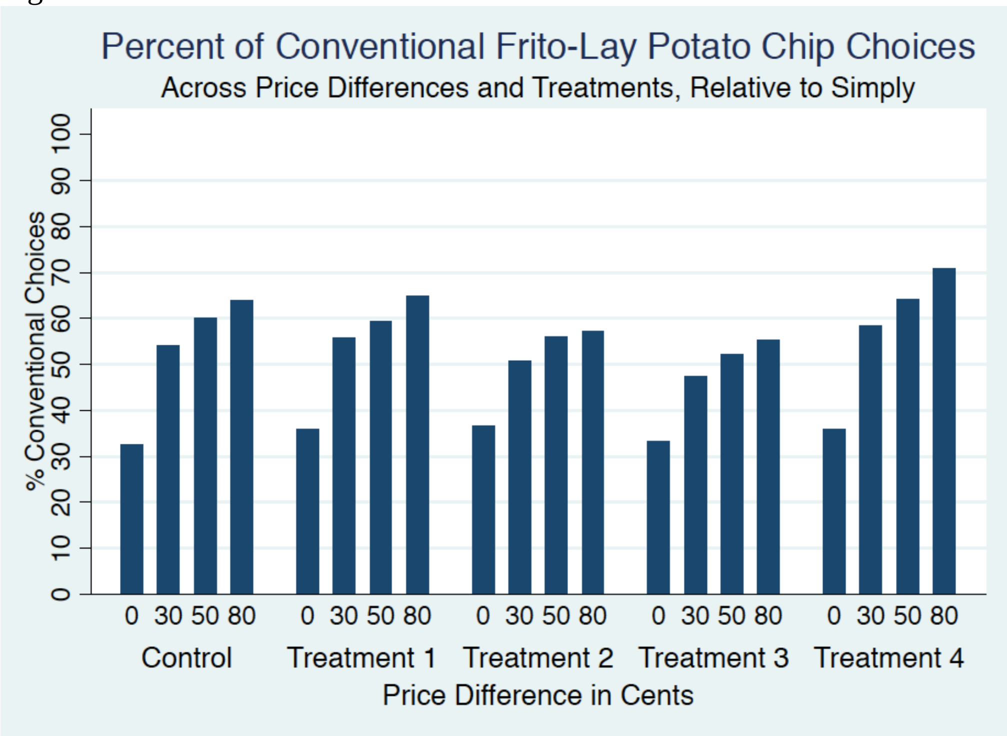


Figure 5.3.1

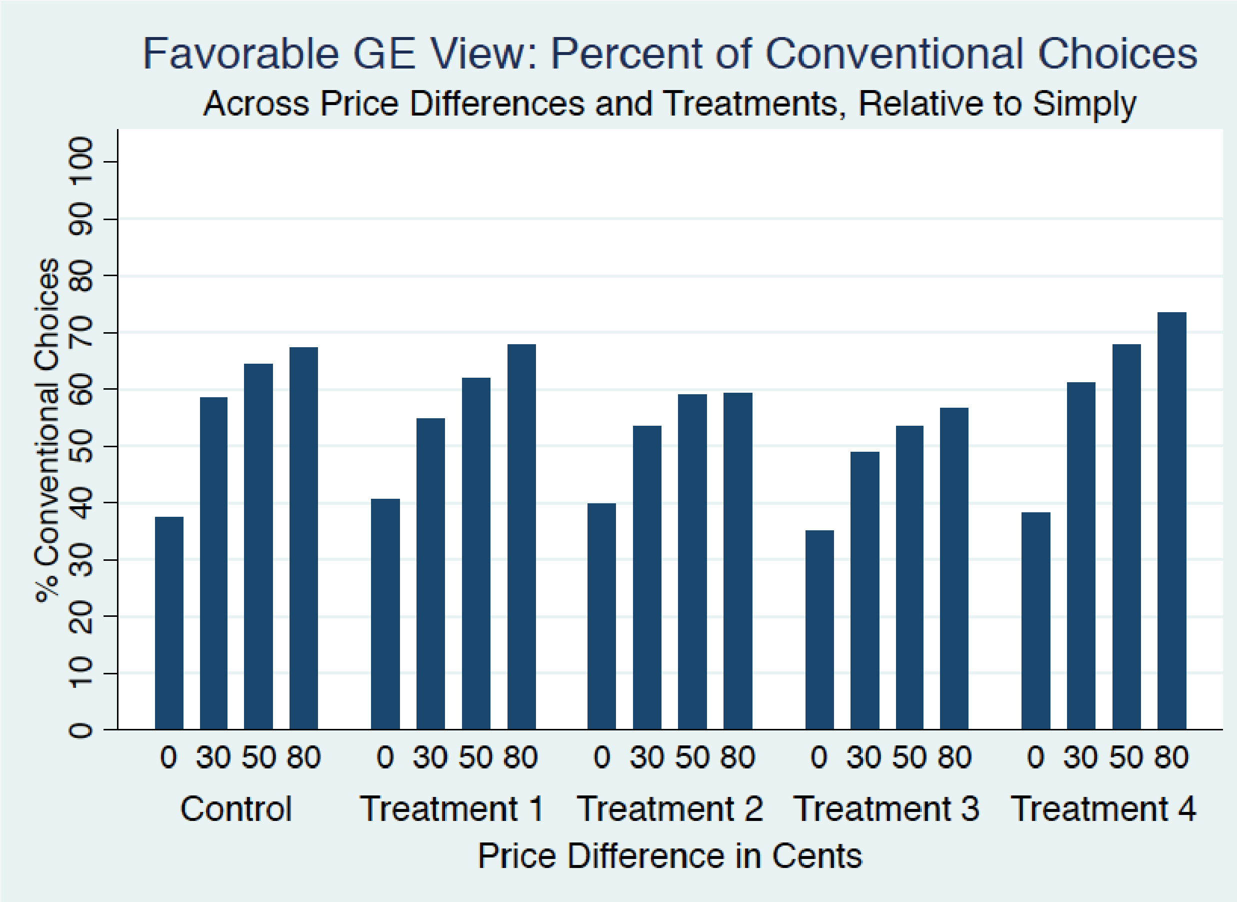

Favorable GE View: Percent of Conventional Choices
Across Price Differences and Treatments, Relative to Simply
% Conventional Choices
0 10 20 30 40 50 60 70 80 90 100
0 30 50 80
Control
Treatment 1
Treatment 2
Treatment 3
Treatment 4
Price Difference in Cents

Figure 5.3.2

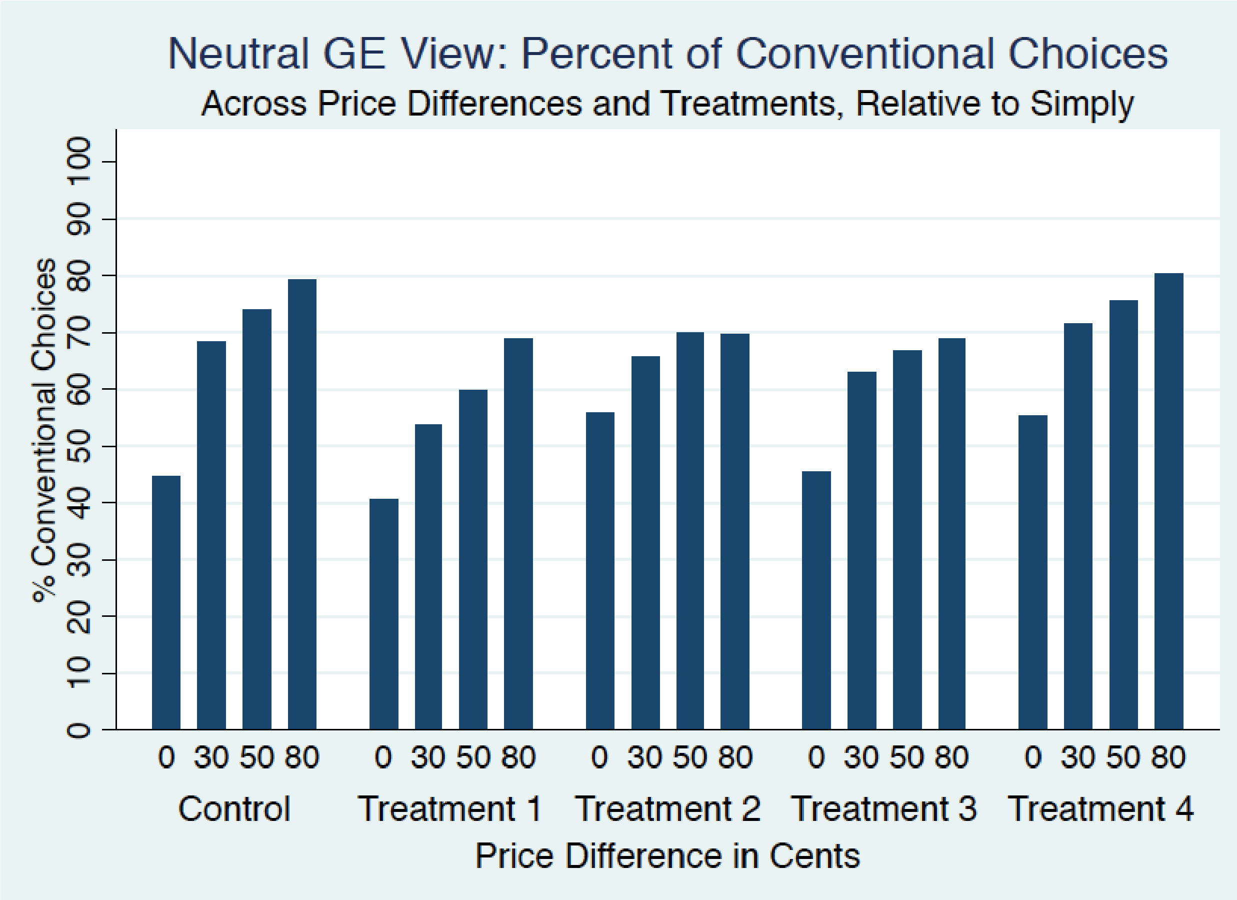
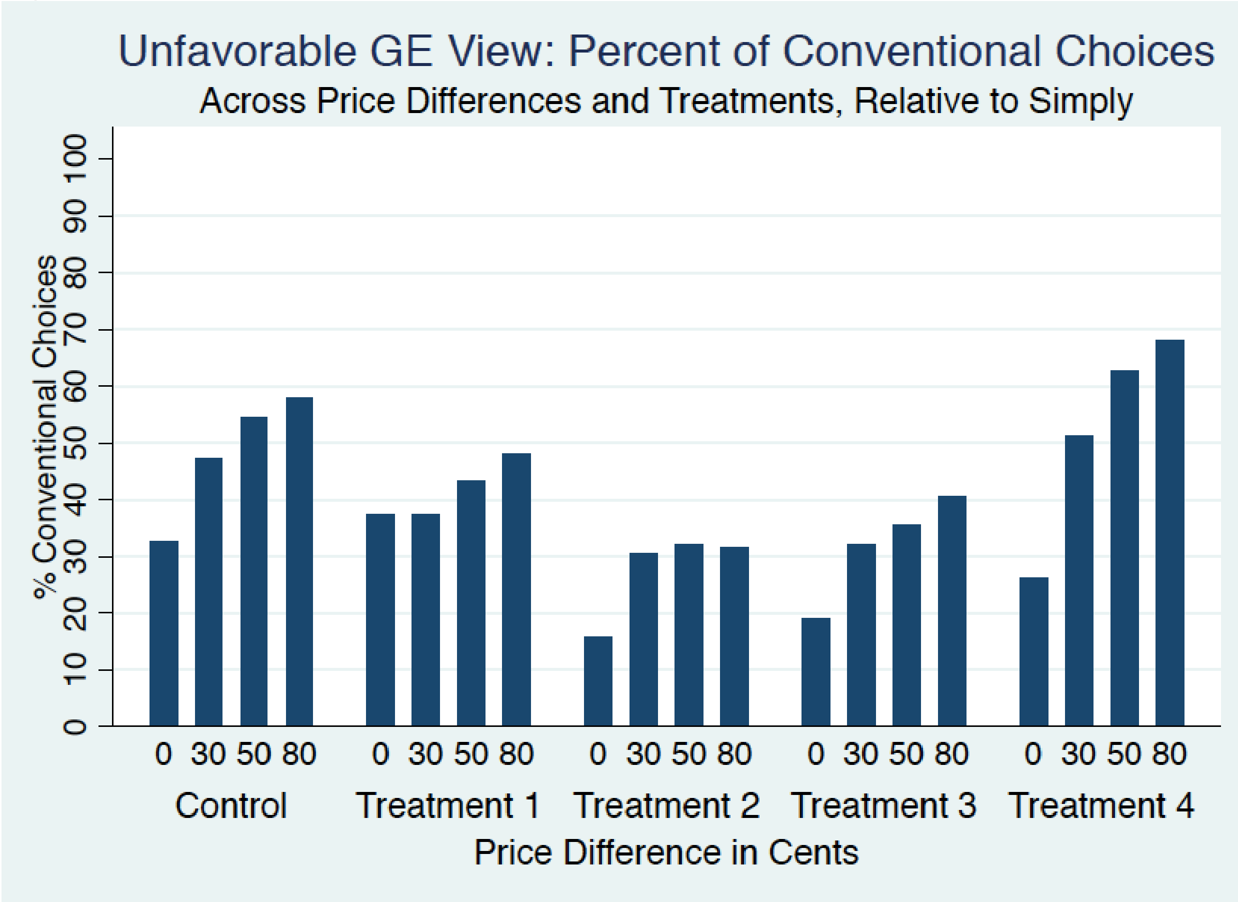

Neutral GE View: Percent of Conventional Choices
Across Price Differences and Treatments, Relative to Simply
% Conventional Choices
0
10
20
30
40
50
60
70
80
90
100
0 30 50 80
Control
Treatment 1
Treatment 2
Treatment 3
Treatment 4
Price Difference in Cents

Figure 5.3.3



Unfavorable GE View: Percent of Conventional Choices
Across Price Differences and Treatments, Relative to Simply
% Conventional Choices
0
10
20
30
40
50
60
70
80
90
100
0 30 50 80
0 30 50 80
0 30 50 80
0 30 50 80
0 30 50 80
Control
Treatment 1
Treatment 2
Treatment 3
Treatment 4
Price Difference in Cents

Table 5.1.1.
Base models with and without interaction term between price difference and treatment variables

VARIABLES	Logit 1 choice	Mixed Logit 1 choice	Logit 1a choice	Mixed Logit 1a choice
Price Difference 30¢	0.704***	1.931***	0.859***	2.370***
	(0.064)	(0.203)	(0.148)	(0.434)
Price Difference 50¢	0.951***	2.848***	1.106***	3.212***
	(0.075)	(0.264)	(0.171)	(0.506)
Price Difference 80¢	1.104***	3.503***	1.241***	3.990***
	(0.083)	(0.314)	(0.183)	(0.582)
Treatment 1	-0.050	-0.371	0.129	0.018
	(0.243)	(0.668)	(0.262)	(0.732)
Treatment 2	-0.211	-0.173	0.097	0.187
	(0.252)	(0.690)	(0.261)	(0.740)
Treatment 3	-0.390	-0.987	-0.107	-0.706
	(0.252)	(0.700)	(0.268)	(0.763)
Treatment 4	0.156	0.518	0.028	0.352
	(0.252)	(0.684)	(0.270)	(0.759)
Price Diff 30¢ * Treatment 1			-0.280	-1.278**
			(0.206)	(0.544)
Price Diff 30¢ * Treatment 2			-0.303	-0.704
			(0.192)	(0.548)
Price Diff 30¢ * Treatment 3			-0.282	-0.537
			(0.197)	(0.584)
Price Diff 30¢ * Treatment 4			0.080	0.408
			(0.216)	(0.603)
Price Diff 50¢ * Treatment 1			-0.235	-0.758
			(0.241)	(0.637)
Price Diff 50¢ * Treatment 2			-0.328	-0.844
			(0.223)	(0.624)
Price Diff 50¢ * Treatment 3			-0.343	-0.609
			(0.229)	(0.685)
Price Diff 50¢ * Treatment 4			0.131	0.342
			(0.261)	(0.705)
Price Diff 80¢ * Treatment 1			-0.105	-0.762
			(0.267)	(0.713)
Price Diff 80¢ * Treatment 2			-0.448*	-1.378*
			(0.239)	(0.708)
Price Diff 80¢ * Treatment 3			-0.357	-1.016
			(0.248)	(0.754)
Price Diff 80¢ * Treatment 4			0.261	0.668
			(0.287)	(0.794)
Potato	0.258***	-0.762***	0.259***	-0.762***
	(0.055)	(0.161)	(0.055)	(0.161)
Non-GMO * Potato	-0.045*	-0.132*	-0.045*	-0.132*
	(0.024)	(0.069)	(0.024)	(0.069)
var(Price Difference 30¢[id])		3.798***		3.522***
		(0.803)		(0.748)
var(Price Difference 50¢[id])		5.584***		5.389***
		(1.095)		(1.062)
var(Price Difference 80¢[id])		8.750***		8.344***
		(1.626)		(1.569)
var(_cons[id])		36.201***		35.985***

		(7.463)		(7.521)
Constant	-0.223	-0.608	-0.350*	-0.779
	(0.180)	(0.503)	(0.188)	(0.540)
Observations	27,160	27,160	27,160	27,160
Number of groups		388		388

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5.1.2.

Base Models with Product Attributes and Socio-Demographic Variables

VARIABLES	Logit 2 choice	Mixed Logit 2 choice	Logit 2a choice	Mixed Logit 2a choice
Price Difference 30¢	0.741***	1.930***	0.913***	2.368***
	(0.068)	(0.203)	(0.161)	(0.434)
Price Difference 50¢	1.001***	2.848***	1.175***	3.208***
	(0.081)	(0.264)	(0.185)	(0.506)
Price Difference 80¢	1.162***	3.502***	1.318***	3.984***
	(0.089)	(0.313)	(0.197)	(0.583)
Treatment 1	-0.085	-0.497	0.116	-0.102
	(0.247)	(0.641)	(0.273)	(0.717)
Treatment 2	-0.257	-0.421	0.075	-0.052
	(0.257)	(0.644)	(0.272)	(0.704)
Treatment 3	-0.486*	-1.368**	-0.172	-1.082
	(0.260)	(0.673)	(0.286)	(0.752)
Treatment 4	0.125	0.185	-0.010	0.004
	(0.260)	(0.660)	(0.286)	(0.753)
Price Diff 30¢ * Treatment 1			-0.306	-1.281**
			(0.220)	(0.545)
Price Diff 30¢ * Treatment 2			-0.327	-0.702
			(0.205)	(0.547)
Price Diff 30¢ * Treatment 3			-0.314	-0.542
			(0.209)	(0.584)
Price Diff 30¢ * Treatment 4			0.084	0.419
			(0.231)	(0.605)
Price Diff 50¢ * Treatment 1			-0.262	-0.757
			(0.255)	(0.638)
Price Diff 50¢ * Treatment 2			-0.354	-0.834
			(0.236)	(0.624)
Price Diff 50¢ * Treatment 3			-0.382	-0.613
			(0.241)	(0.685)
Price Diff 50¢ * Treatment 4			0.138	0.359
			(0.279)	(0.709)
Price Diff 80¢ * Treatment 1			-0.128	-0.761
			(0.282)	(0.715)
Price Diff 80¢ * Treatment 2			-0.481*	-1.369*
			(0.253)	(0.707)
Price Diff 80¢ * Treatment 3			-0.399	-1.020
			(0.261)	(0.754)
Price Diff 80¢ * Treatment 4			0.273	0.688
			(0.306)	(0.798)
Potato	-0.271***	-0.762***	-0.272***	-0.762***
	(0.058)	(0.161)	(0.058)	(0.161)
Non-GMO * Potato	-0.047*	-0.132*	-0.047*	-0.132*
	(0.025)	(0.069)	(0.025)	(0.069)
Age	-0.071**	-0.203***	-0.071**	-0.204***
	(0.032)	(0.076)	(0.032)	(0.076)
Age^2	0.001***	0.003***	0.001***	0.003***
	(0.000)	(0.001)	(0.000)	(0.001)
Female	-0.220	-0.712*	-0.221	-0.711*
	(0.165)	(0.427)	(0.165)	(0.428)

Married or Domestic Partner	-0.379*		-1.136**	-0.379*	-1.127**
	(0.194)		(0.510)	(0.194)	(0.509)
Other Relationship Status	-0.974***		-4.138***	-0.976***	-4.124***
	(0.297)		(0.811)	(0.297)	(0.810)
Ethnicity	-0.107		-0.098	-0.108	-0.102
	(0.084)		(0.212)	(0.085)	(0.213)
Income	-0.183**		-0.512***	-0.182**	-0.515***
	(0.072)		(0.192)	(0.073)	(0.193)
Education	-0.044		-0.608***	-0.045	-0.619***
	(0.088)		(0.216)	(0.088)	(0.219)
Constant	2.095***		7.108***	1.967***	6.981***
	(0.759)		(1.867)	(0.751)	(1.891)
var(Price Difference 30¢[id])			3.765***		3.488***
			(0.795)		(0.740)
var(Price Difference 50¢[id])			5.565***		5.369***
			(1.087)		(1.054)
var(Price Difference 80¢[id])			8.742***		8.332***
			(1.617)		(1.558)
var(_cons[id])			31.873***		31.595***
			(6.029)		(6.018)
Observations	27,160		27,160	27,160	27,160
Number of groups			388		388

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5.1.3.
Base Models with Product Attributes, Socio-Demographic and GE Attitudinal Variables

VARIABLES	Logit 3 choice	Mixed Logit 3 choice	Logit 3a choice	Mixed Logit 3a choice
Price Difference 30¢	0.830***	1.935***	1.032***	2.390***
	(0.077)	(0.203)	(0.185)	(0.435)
Price Difference 50¢	1.124***	2.857***	1.332***	3.233***
	(0.091)	(0.264)	(0.212)	(0.506)
Price Difference 80¢	1.306***	3.518***	1.496***	4.018***
	(0.100)	(0.311)	(0.228)	(0.582)
Treatment 1	-0.067	-0.347	0.165	0.071
	(0.247)	(0.554)	(0.294)	(0.646)
Treatment 2	-0.238	-0.261	0.145	0.142
	(0.261)	(0.570)	(0.293)	(0.647)
Treatment 3	-0.401	-0.807	-0.045	-0.498
	(0.262)	(0.577)	(0.302)	(0.671)
Treatment 4	0.280	0.683	0.153	0.508
	(0.271)	(0.600)	(0.324)	(0.698)
Price Diff 30¢ * Treatment 1			-0.350	-1.300**
			(0.247)	(0.543)
Price Diff 30¢ * Treatment 2			-0.377	-0.722
			(0.231)	(0.546)
Price Diff 30¢ * Treatment 3			-0.358	-0.553
			(0.237)	(0.582)
Price Diff 30¢ * Treatment 4			0.074	0.383
			(0.262)	(0.601)
Price Diff 50¢ * Treatment 1			-0.304	-0.774
			(0.286)	(0.636)
Price Diff 50¢ * Treatment 2			-0.413	-0.854
			(0.265)	(0.623)
Price Diff 50¢ * Treatment 3			-0.436	-0.623
			(0.273)	(0.684)
Price Diff 50¢ * Treatment 4			0.125	0.325
			(0.316)	(0.705)
Price Diff 80¢ * Treatment 1			-0.156	-0.780
			(0.315)	(0.712)
Price Diff 80¢ * Treatment 2			-0.559*	-1.382*
			(0.285)	(0.706)
Price Diff 80¢ * Treatment 3			-0.455	-1.036
			(0.297)	(0.751)
Price Diff 80¢ * Treatment 4			0.270	0.643
			(0.344)	(0.791)
Potato	-0.306***	-0.762***	-0.306***	-0.762***
	(0.065)	(0.161)	(0.065)	(0.161)
Non-GMO * Potato	-0.053*	-0.132*	-0.053*	-0.132*
	(0.028)	(0.069)	(0.028)	(0.069)
Age	-0.101***	-0.224***	-0.102***	-0.225***
	(0.033)	(0.071)	(0.033)	(0.071)
Age^2	0.001***	0.003***	0.001***	0.003***
	(0.000)	(0.001)	(0.000)	(0.001)
Female	-0.152	-0.443	-0.155	-0.441

	(0.176)	(0.385)	(0.177)	(0.385)
Married or Domestic Partner	-0.360*	-0.808*	-0.360*	-0.799*
	(0.197)	(0.448)	(0.198)	(0.447)
Other Relationship Status	-0.926***	-3.206***	-0.925***	-3.181***
	(0.312)	(0.703)	(0.312)	(0.701)
Ethnicity	0.012	0.308	0.011	0.304
	(0.096)	(0.215)	(0.096)	(0.215)
Income	-0.166**	-0.364**	-0.166**	-0.369**
	(0.074)	(0.171)	(0.074)	(0.171)
Education	0.010	-0.304	0.009	-0.312
	(0.092)	(0.192)	(0.092)	(0.193)
Sometimes Avoid GE Ingredients	0.750***	2.429***	0.752***	2.419***
	(0.262)	(0.638)	(0.262)	(0.633)
Does Not Avoid GE Ingredients	0.804***	2.447***	0.805***	2.447***
	(0.290)	(0.702)	(0.291)	(0.698)
Somewhat Unfavorable View of GE	0.494	1.627**	0.501	1.602**
	(0.361)	(0.816)	(0.363)	(0.817)
Neutral View of GE	0.783**	3.086***	0.790**	3.047***
	(0.307)	(0.698)	(0.309)	(0.701)
Somewhat Favorable View of GE	0.812**	2.602***	0.822**	2.551***
	(0.338)	(0.801)	(0.339)	(0.802)
Very Favorable View of GE	1.031***	4.131***	1.040***	4.090***
	(0.382)	(0.819)	(0.383)	(0.819)
Fair Understanding of GE	-0.646**	-2.455***	-0.644**	-2.417***
	(0.326)	(0.615)	(0.326)	(0.617)
Good Understanding of GE	-1.159***	-3.866***	-1.158***	-3.845***
	(0.327)	(0.657)	(0.328)	(0.660)
Excellent Understanding of GE	-1.249***	-3.678***	-1.250***	-3.663***
	(0.419)	(0.821)	(0.420)	(0.820)
GE May Pose Threat to Health	-0.170**	-0.591***	-0.169**	-0.591***
	(0.084)	(0.198)	(0.084)	(0.199)
Constant	2.464**	5.985***	2.298**	5.852***
	(0.994)	(2.056)	(0.988)	(2.074)
var(Price Difference 30¢[id])		3.699***		3.426***
		(0.774)		(0.720)
var(Price Difference 50¢[id])		5.478***		5.288***
		(1.057)		(1.024)
var(Price Difference 80¢[id])		8.642***		8.248***
		(1.562)		(1.508)
var(_cons[id])		22.924***		22.694***
		(3.769)		(3.734)
Observations	27,160	27,160	27,160	27,160
Number of groups		388		388

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5.2.1.
***Omits Participants That Only Chose Conventional or Simply Version Through Entire Survey**
Base Models with Attributes, Socio-Demographic, and GE Attitudinal Variables

VARIABLES	Logit 4 choice	Mixed Logit 4 choice	Logit 4a choice	Mixed Logit 4a choice
Price Difference 30¢	0.930***	1.951***	1.133***	2.392***
	(0.083)	(0.202)	(0.196)	(0.424)
Price Difference 50¢	1.295***	2.951***	1.501***	3.312***
	(0.100)	(0.274)	(0.227)	(0.507)
Price Difference 80¢	1.538***	3.777***	1.717***	4.239***
	(0.113)	(0.344)	(0.246)	(0.596)
Treatment 1	-0.070	-0.046	0.172	0.293
	(0.235)	(0.455)	(0.290)	(0.522)
Treatment 2	-0.107	0.339	0.255	0.618
	(0.254)	(0.483)	(0.291)	(0.534)
Treatment 3	-0.294	-0.128	0.059	0.101
	(0.255)	(0.497)	(0.298)	(0.555)
Treatment 4	0.190	0.257	0.053	0.126
	(0.255)	(0.478)	(0.313)	(0.549)
Price Diff 30¢ * Treatment 1			-0.379	-1.269**
			(0.266)	(0.523)
Price Diff 30¢ * Treatment 2			-0.365	-0.668
			(0.255)	(0.530)
Price Diff 30¢ * Treatment 3			-0.359	-0.553
			(0.259)	(0.559)
Price Diff 30¢ * Treatment 4			0.071	0.344
			(0.276)	(0.580)
Price Diff 50¢ * Treatment 1			-0.333	-0.769
			(0.314)	(0.628)
Price Diff 50¢ * Treatment 2			-0.388	-0.772
			(0.296)	(0.614)
Price Diff 50¢ * Treatment 3			-0.451	-0.610
			(0.302)	(0.665)
Price Diff 50¢ * Treatment 4			0.136	0.283
			(0.341)	(0.690)
Price Diff 80¢ * Treatment 1			-0.142	-0.784
			(0.351)	(0.707)
Price Diff 80¢ * Treatment 2			-0.579*	-1.304*
			(0.324)	(0.702)
Price Diff 80¢ * Treatment 3			-0.475	-0.992
			(0.333)	(0.741)
Price Diff 80¢ * Treatment 4			0.344	0.625
			(0.383)	(0.783)
Potato	-0.386***	-0.761***	0.386***	-0.761***
	(0.081)	(0.161)	(0.082)	(0.161)
Non-GMO * Potato	-0.064*	-0.131*	-0.064*	-0.131*
	(0.034)	(0.069)	(0.034)	(0.069)

			-	
Age	-0.101***	-0.160***	0.101***	-0.163***
	(0.031)	(0.057)	(0.031)	(0.057)
Age²	0.001***	0.002***	0.001***	0.002***
	(0.000)	(0.001)	(0.000)	(0.001)
Female	-0.224	-0.421	-0.228	-0.435
	(0.171)	(0.325)	(0.171)	(0.326)
Married or Domestic Partner	-0.257	-0.205	-0.260	-0.214
	(0.184)	(0.349)	(0.185)	(0.350)
Other Relationship Status	-0.641**	-1.503***	-0.644**	-1.508***
	(0.295)	(0.568)	(0.296)	(0.569)
Ethnicity	-0.049	0.102	-0.051	0.101
	(0.095)	(0.188)	(0.096)	(0.188)
Income	-0.208***	-0.313**	0.208***	-0.318**
	(0.071)	(0.144)	(0.071)	(0.143)
Education	0.043	-0.095	0.042	-0.097
	(0.091)	(0.169)	(0.091)	(0.170)
Sometimes Avoid GE Ingredients	0.380	0.584	0.381	0.580
	(0.257)	(0.514)	(0.258)	(0.514)
Does Not Avoid GE Ingredients	0.370	0.538	0.370	0.535
	(0.282)	(0.554)	(0.283)	(0.556)
Somewhat Unfavorable View of GE	0.381	0.868	0.385	0.844
	(0.383)	(0.768)	(0.386)	(0.774)
Neutral View of GE	0.356	1.131*	0.362	1.118*
	(0.314)	(0.664)	(0.318)	(0.668)
Somewhat Favorable View of GE	0.316	0.283	0.325	0.267
	(0.342)	(0.736)	(0.345)	(0.738)
Very Favorable View of GE	0.723**	2.126***	0.731**	2.122***
	(0.368)	(0.716)	(0.369)	(0.712)
Fair Understanding of GE	-0.501	-1.391***	-0.499	-1.380***
	(0.307)	(0.522)	(0.307)	(0.528)
Good Understanding of GE	-0.829***	-1.773***	0.828***	-1.775***
	(0.311)	(0.543)	(0.311)	(0.548)
Excellent Understanding of GE	-1.336***	-2.843***	1.337***	-2.858***
	(0.380)	(0.674)	(0.380)	(0.672)
GE May Pose Threat to Health	-0.149*	-0.293*	-0.148*	-0.292*
	(0.085)	(0.165)	(0.085)	(0.166)
Constant	3.264***	5.746***	3.110***	5.676***
	(0.877)	(1.686)	(0.885)	(1.701)
var(Price Difference 30¢[id])		3.618***		3.364***
		(0.761)		(0.709)
var(Price Difference 50¢[id])		5.640***		5.436***
		(1.123)		(1.084)
var(Price Difference 80¢[id])		9.184***		8.694***
		(1.819)		(1.730)
var(_cons[id])		8.997***		8.989***
		(1.168)		(1.165)
Observations	22,890	22,890	22,890	22,890

Number of groups	327	327

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5.3.1.
Segmented by GE View: Results Only Include Those With A Favorable View of GE
Base Models with Attributes, Socio-Demographic, and GE Attitudinal Variables

	Logit 5	Mixed Logit 5	Logit 5a	Mixed Logit 5a
VARIABLES	Choice	Choice	Choice	Choice
Price Difference 30¢	1.121***	2.220***	1.616***	2.777***
	(0.182)	(0.418)	(0.515)	(0.928)
Price Difference 50¢	1.507***	3.359***	1.845***	3.500***
	(0.216)	(0.574)	(0.591)	(1.157)
Price Difference 80¢	1.620***	3.701***	1.654***	3.422***
	(0.228)	(0.690)	(0.558)	(1.214)
Treatment 1	1.487**	2.547*	1.324*	2.489*
	(0.589)	(1.491)	(0.719)	(1.492)
Treatment 2	0.637	1.743	1.021*	1.842
	(0.525)	(1.365)	(0.590)	(1.338)
Treatment 3	0.074	-0.031	0.933	0.529
	(0.523)	(1.346)	(0.610)	(1.291)
Treatment 4	0.677	1.639	0.757	1.486
	(0.526)	(1.359)	(0.716)	(1.350)
Price Diff 30¢ * Treatment 1			-0.125	-0.516
			(0.709)	(1.150)
Price Diff 30¢ * Treatment 2			-0.715	-0.768
			(0.578)	(1.099)
Price Diff 30¢ * Treatment 3			-1.157**	-1.639
			(0.580)	(1.183)
Price Diff 30¢ * Treatment 4			-0.237	0.104
			(0.683)	(1.278)
Price Diff 50¢ * Treatment 1			0.330	0.861
			(0.896)	(1.496)
Price Diff 50¢ * Treatment 2			-0.440	-0.316
			(0.659)	(1.307)
Price Diff 50¢ * Treatment 3			-1.041	-1.523
			(0.685)	(1.469)
Price Diff 50¢ * Treatment 4			-0.270	0.192
			(0.793)	(1.540)
Price Diff 80¢ * Treatment 1			0.563	1.059
			(0.862)	(1.468)
Price Diff 80¢ * Treatment 2			-0.147	-0.131
			(0.661)	(1.409)
Price Diff 80¢ * Treatment 3			-0.722	-0.924
			(0.676)	(1.587)
Price Diff 80¢ * Treatment 4			0.290	1.167
			(0.793)	(1.590)
Potato	-0.495***	-1.034***	-0.498***	-1.034***
	(0.142)	(0.302)	(0.142)	(0.302)
Non-GMO * Potato	-0.020	-0.043	-0.020	-0.043

	(0.061)	(0.131)	(0.062)	(0.131)
Age	-0.210***	-0.399***	-0.211***	-0.396***
	(0.056)	(0.138)	(0.056)	(0.135)
Age²	0.002***	0.004***	0.002***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Female	-0.286	-0.016	-0.295	-0.004
	(0.315)	(0.731)	(0.316)	(0.705)
Married or Domestic Partner	0.095	0.287	0.093	0.275
	(0.401)	(1.109)	(0.399)	(1.063)
Other Relationship Status	-1.022	-3.744**	-1.020	-3.679**
	(0.674)	(1.717)	(0.676)	(1.687)
Black	0.392	1.786	0.390	1.621
	(0.457)	(1.132)	(0.455)	(1.087)
Hispanic	-0.751	-3.014**	-0.771	-2.968**
	(0.573)	(1.307)	(0.585)	(1.250)
Asian	-1.166	-3.625*	-1.200*	-3.713*
	(0.722)	(1.973)	(0.728)	(1.974)
Other Ethnicity	1.179*	1.827	1.202**	1.879
	(0.604)	(1.673)	(0.601)	(1.603)
Income 25-50K	-1.296**	-4.053***	-1.294**	-3.956***
	(0.541)	(1.257)	(0.549)	(1.215)
Income 50-100K	-2.088***	-4.702***	-2.083***	-4.588***
	(0.626)	(1.335)	(0.634)	(1.294)
Income > 100K	-1.809***	-3.764***	-1.795***	-3.703***
	(0.605)	(1.221)	(0.612)	(1.198)
Some College	0.781*	1.451	0.782	1.396
	(0.474)	(1.059)	(0.476)	(1.018)
College Grad or Higher	0.620	0.648	0.597	0.607
	(0.463)	(0.921)	(0.468)	(0.903)
Avoids GE	-0.026	0.797	-0.030	0.744
	(0.398)	(0.984)	(0.401)	(0.961)
Does Not Avoid GE Ingredients	0.897**	0.889	0.906**	0.859
	(0.443)	(1.258)	(0.443)	(1.203)
GE May Pose Threat to Health	-0.033	-0.433	-0.030	-0.410
	(0.152)	(0.382)	(0.153)	(0.364)
Fair Understanding of GE	-1.295	-4.111**	-1.305	-4.051*
	(1.181)	(2.077)	(1.173)	(2.086)
Good Understanding of GE	-0.506	-1.508	-0.514	-1.480
	(1.181)	(1.851)	(1.173)	(1.881)
Excellent Understanding of GE	-0.574	-0.524	-0.594	-0.524
	(1.188)	(1.901)	(1.183)	(1.940)
Constant	4.842**	11.295***	4.634**	11.059***
	(1.957)	(4.147)	(1.972)	(4.065)
var(Price Difference 30¢[id])		5.579***		5.199***
		(2.012)		(1.927)
var(Price Difference 50¢[id])		10.422***		10.218***

		(3.545)		(3.464)
var(Price Difference 80¢[id])		13.714**		13.319**
		(5.478)		(5.318)
var(_cons[id])		10.737***		10.121***
		(3.578)		(3.276)
Observations	7,350	7,350	7,350	7,350
Number of groups		105		105

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5.3.2.
Segmented by GE View: Results Only Include Those With A Neutral View of GE
Base Models with Attributes, Socio-Demographic, and GE Attitudinal Variables

VARIABLES	Logit 6 Choice	Mixed Logit 6 Choice	Logit 6a Choice	Mixed Logit 6a Choice
Price Difference 30¢	0.809***	1.577***	1.196***	2.041***
	(0.114)	(0.250)	(0.328)	(0.567)
Price Difference 50¢	1.073***	2.318***	1.528***	2.878***
	(0.133)	(0.340)	(0.360)	(0.691)
Price Difference 80¢	1.330***	3.113***	1.883***	3.858***
	(0.155)	(0.431)	(0.403)	(0.833)
Treatment 1	-0.676*	-1.121*	-0.248	-0.691
	(0.355)	(0.665)	(0.437)	(0.773)
Treatment 2	-0.236	-0.107	0.463	0.373
	(0.429)	(0.787)	(0.483)	(0.866)
Treatment 3	-0.724*	-1.035	-0.289	-0.961
	(0.406)	(0.776)	(0.475)	(0.879)
Treatment 4	0.117	0.467	0.405	0.547
	(0.445)	(0.806)	(0.540)	(0.926)
Price Diff 30¢ * Treatment 1			-0.546	-1.099
			(0.391)	(0.675)
Price Diff 30¢ * Treatment 2			-0.671*	-0.928
			(0.377)	(0.653)
Price Diff 30¢ * Treatment 3			-0.366	-0.006
			(0.401)	(0.759)
Price Diff 30¢ * Treatment 4			-0.302	-0.011
			(0.424)	(0.772)
Price Diff 50¢ * Treatment 1			-0.572	-0.985
			(0.431)	(0.787)
Price Diff 50¢ * Treatment 2			-0.761*	-1.171
			(0.434)	(0.803)
Price Diff 50¢ * Treatment 3			-0.507	-0.182
			(0.451)	(0.905)
Price Diff 50¢ * Treatment 4			-0.377	-0.464
			(0.497)	(0.913)
Price Diff 80¢ * Treatment 1			-0.442	-0.897
			(0.497)	(0.959)
Price Diff 80¢ * Treatment 2			-1.134**	-1.810*
			(0.474)	(0.951)
Price Diff 80¢ * Treatment 3			-0.749	-0.796
			(0.499)	(1.018)
Price Diff 80¢ * Treatment 4			-0.380	-0.285
			(0.590)	(1.132)
Potato	-0.320***	-0.634***	-0.321***	-0.634***
	(0.121)	(0.240)	(0.122)	(0.240)
Non-GMO * Potato	-0.098**	-0.197**	-0.098**	-0.197**

	(0.049)	(0.098)	(0.049)	(0.098)
Age	-0.097**	-0.180**	-0.098**	-0.181**
	(0.049)	(0.087)	(0.048)	(0.086)
Age²	0.001**	0.002***	0.001**	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Female	0.084	-0.041	0.086	-0.036
	(0.260)	(0.508)	(0.261)	(0.506)
Married or Domestic Partner	-0.700**	-0.708	-0.705**	-0.718
	(0.282)	(0.549)	(0.283)	(0.546)
Other Relationship Status	-1.431***	-3.034***	-1.435***	-3.047***
	(0.450)	(0.847)	(0.453)	(0.842)
Black	-0.422	0.372	-0.418	0.392
	(0.756)	(1.375)	(0.759)	(1.377)
Hispanic	-0.474	0.581	-0.480	0.568
	(0.924)	(1.585)	(0.920)	(1.597)
Asian	0.500	0.691	0.485	0.664
	(0.605)	(1.015)	(0.610)	(1.010)
Income 25-50K	-0.218	-0.864	-0.212	-0.853
	(0.311)	(0.591)	(0.313)	(0.590)
Income 50-100K	-0.480	-1.095	-0.479	-1.083
	(0.391)	(0.698)	(0.394)	(0.696)
Income > 100K	-0.858**	-2.631***	-0.855**	-2.607***
	(0.398)	(0.798)	(0.400)	(0.792)
Some College	0.462	0.410	0.463	0.424
	(0.299)	(0.590)	(0.300)	(0.590)
College Grad or Higher	-0.207	-0.438	-0.209	-0.425
	(0.306)	(0.587)	(0.307)	(0.585)
Avoids GE	-2.091***	-5.209***	-2.106***	-5.158***
	(0.551)	(1.210)	(0.550)	(1.174)
Does Not Avoid GE Ingredients	0.066	0.330	0.065	0.338
	(0.256)	(0.521)	(0.256)	(0.521)
GE May Pose Threat to Health	-0.262**	-0.617**	-0.264**	-0.628**
	(0.126)	(0.253)	(0.127)	(0.254)
Fair Understanding of GE	-0.218	-0.735	-0.220	-0.732
	(0.351)	(0.645)	(0.353)	(0.645)
Good Understanding of GE	-0.744*	-2.153***	-0.748*	-2.172***
	(0.391)	(0.751)	(0.395)	(0.752)
Excellent Understanding of GE	-0.259	-1.875*	-0.256	-1.877*
	(0.854)	(1.090)	(0.855)	(1.120)
Constant	3.980***	8.410***	3.625***	8.232***
	(1.260)	(2.298)	(1.263)	(2.299)
var(Price Difference 30¢[id])		2.159***		1.962***
		(0.802)		(0.733)
var(Price Difference 50¢[id])		3.365***		3.137***
		(1.140)		(1.077)
var(Price Difference 80¢[id])		6.311***		5.855***

		(1.866)		(1.762)
var(_cons[id])		12.354***		12.292***
		(2.486)		(2.462)
Observations	11,900	11,900	11,900	11,900
Number of groups		170		170

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5.3.3.
Segmented by GE View: Results Only Include Those With An Unfavorable View of GE
Base Models with Attributes, Socio-Demographic, and GE Attitudinal Variables

	Logit 7	Mixed Logit 7	Logit 7a	Mixed Logit 7a
VARIABLES	Choice	Choice	Choice	Choice
Price Difference 30¢	0.948***	2.443***	0.799***	2.724***
	(0.176)	(0.486)	(0.252)	(0.846)
Price Difference 50¢	1.325***	3.557***	1.170***	3.630***
	(0.198)	(0.565)	(0.322)	(0.889)
Price Difference 80¢	1.541***	4.408***	1.369***	4.722***
	(0.217)	(0.668)	(0.364)	(1.118)
Treatment 1	0.234	-1.529	0.930	0.243
	(0.620)	(1.511)	(0.719)	(1.744)
Treatment 2	-1.210**	-4.063***	-1.327*	-3.819*
	(0.581)	(1.501)	(0.773)	(2.087)
Treatment 3	-0.378	-1.492	-0.434	-0.783
	(0.580)	(1.230)	(0.743)	(1.515)
Treatment 4	0.267	0.308	-0.461	-0.210
	(0.545)	(1.279)	(0.608)	(1.465)
Price Diff 30¢ * Treatment 1			-0.799**	-3.601***
			(0.388)	(1.333)
Price Diff 30¢ * Treatment 2			0.393	0.427
			(0.614)	(1.627)
Price Diff 30¢ * Treatment 3			0.139	-0.815
			(0.500)	(1.173)
Price Diff 30¢ * Treatment 4			0.636	0.700
			(0.441)	(1.148)
Price Diff 50¢ * Treatment 1			-0.818*	-2.335*
			(0.431)	(1.210)
Price Diff 50¢ * Treatment 2			0.131	-0.244
			(0.643)	(1.584)
Price Diff 50¢ * Treatment 3			-0.011	-0.825
			(0.569)	(1.336)
Price Diff 50¢ * Treatment 4			0.899	0.968
			(0.565)	(1.262)
Price Diff 80¢ * Treatment 1			-0.755	-2.871*
			(0.558)	(1.538)
Price Diff 80¢ * Treatment 2			-0.104	-0.827
			(0.671)	(1.869)
Price Diff 80¢ * Treatment 3			0.097	-1.554
			(0.656)	(1.576)
Price Diff 80¢ * Treatment 4			1.010	1.150
			(0.619)	(1.475)
Potato	-0.230**	-0.681**	-0.232**	-0.681**
	(0.102)	(0.296)	(0.103)	(0.296)
Non-GMO * Potato	-0.034	-0.099	-0.034	-0.099

	(0.052)	(0.150)	(0.053)	(0.150)
Age	-0.117	-0.346**	-0.117	-0.325*
	(0.074)	(0.173)	(0.075)	(0.168)
Age²	0.001*	0.004**	0.001*	0.004**
	(0.001)	(0.002)	(0.001)	(0.002)
Female	-0.175	-0.538	-0.165	-0.518
	(0.497)	(1.080)	(0.497)	(1.089)
Married or Domestic Partner	-0.116	-1.170	-0.113	-1.178
	(0.518)	(1.105)	(0.523)	(1.083)
Other Relationship Status	-0.325	-0.860	-0.340	-0.935
	(0.658)	(1.586)	(0.665)	(1.620)
Black	-0.112	2.555	-0.113	2.308
	(0.699)	(1.935)	(0.693)	(1.871)
Hispanic	0.082	0.489	0.078	0.473
	(0.606)	(1.480)	(0.606)	(1.442)
Asian	-1.534	-3.201	-1.559	-3.512
	(1.224)	(2.243)	(1.245)	(2.330)
Other Ethnicity	1.473*	8.701***	1.481*	8.474***
	(0.882)	(2.396)	(0.877)	(2.380)
Income 25-50K	-0.274	2.052	-0.279	2.094
	(0.570)	(1.514)	(0.578)	(1.486)
Income 50-100K	-0.095	2.164	-0.101	2.132
	(0.614)	(1.546)	(0.621)	(1.541)
Income > 100K	-0.191	0.595	-0.190	0.632
	(0.616)	(1.743)	(0.625)	(1.699)
Some College	0.238	-2.422*	0.234	-2.434*
	(0.564)	(1.286)	(0.567)	(1.301)
College Grad or Higher	0.204	-1.263	0.203	-1.479
	(0.526)	(1.116)	(0.533)	(1.102)
Avoids GE	-0.741	-3.210***	-0.753	-2.946**
	(0.479)	(1.239)	(0.487)	(1.241)
Does Not Avoid GE Ingredients	-0.845	-1.311	-0.860	-1.269
	(0.708)	(1.574)	(0.713)	(1.545)
GE May Pose Threat to Health	-0.723***	-2.475***	-0.723***	-2.411***
	(0.235)	(0.633)	(0.235)	(0.655)
Fair Understanding of GE	-0.387	-4.056**	-0.377	-3.905**
	(0.784)	(1.712)	(0.782)	(1.802)
Good Understanding of GE	-2.295***	-11.149***	-2.309***	-10.986***
	(0.759)	(2.142)	(0.758)	(2.246)
Excellent Understanding of GE	-1.689*	-7.411***	-1.685*	-7.549***
	(0.920)	(2.097)	(0.912)	(2.184)
Constant	5.707**	20.500***	5.856**	19.698***
	(2.392)	(5.595)	(2.396)	(5.752)
var(Price Difference 30¢[id])		4.535**		3.452**
		(1.878)		(1.408)
var(Price Difference 50¢[id])		4.349**		3.698**

		(1.870)		(1.607)
var(Price Difference 80¢[id])		7.916***		6.844***
		(2.959)		(2.636)
var(_cons[id])		38.665***		37.506***
		(13.946)		(14.218)
Observations	7,910	7,910	7,910	7,910
Number of groups		113		113

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Factor Analysis
Table 5.4.1 Base Models with Risk and GE Threat Factor Terms

VARIABLES	Logit Choice
Price Difference 30¢	0.847***
	(0.078)
Price Difference 50¢	1.147***
	(0.092)
Price Difference 80¢	1.332***
	(0.101)
Treatment 1	0.120
	(0.261)
Treatment 2	-0.074
	(0.266)
Treatment 3	-0.321
	(0.263)
Treatment 4	0.418
	(0.275)
Potato	-0.312***
	(0.066)
Non-GMO * Potato	-0.054*
	(0.029)
Age	-0.101***
	(0.033)
Age²	0.001***
	(0.000)
Female	-0.182
	(0.176)
Married or Domestic Partner	-0.276
	(0.199)
Other Relationship Status	-1.056***
	(0.300)
Black	0.416
	(0.350)
Hispanic	-0.470
	(0.402)
Asian	-0.448
	(0.461)
Income 25-50K	1.343*
	(0.725)
Income 50-100K	-0.505**
	(0.222)
income_50_100K	-0.654**
	(0.277)
Income > 100K	-0.799***
	(0.269)

Some College	0.351
	(0.217)
College Grad or Higher	0.102
	(0.225)
Sometimes Avoids GE	0.664**
	(0.268)
Does Not Avoid GE Ingredients	0.679**
	(0.317)
Somewhat Unfavorable View of GE	0.695*
	(0.363)
Neutral View of GE	0.950***
	(0.315)
Somewhat Favorable View of GE	0.851**
	(0.341)
Very Favorable View of GE	1.176***
	(0.382)
Fair Understanding of GE	-0.576*
	(0.341)
Good Understanding of GE	-1.081***
	(0.341)
Excellent Understanding of GE	-1.098**
	(0.435)
GE Threats	-0.203*
	(0.106)
Risk	-0.024
	(0.038)
Constant	2.408**
	(0.998)
Observations	27,160

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure 5.4.1 Correlation Matrix Between GE Threat Variables

	health	environment	skeptical	religious	moral
ge_threat_health	1				
ge_threat_environment	0.836	1			
ge_threat_skeptical	0.5921	0.5653	1		
ge_threat_religious	0.4036	0.353	0.7204	1	
ge_threat_moral	0.7075	0.6593	0.5521	0.402	1

Figure 5.4.2 Correlation Matrix Between Risk Variables

	Risk in Business	Risk in Career	Risk in Education
Risk in Business	1		
Risk in Career	0.6256	1	
Risk in Education	0.4026	0.6759	1

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